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The British Journal of Surgery

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EPONYMS.

BY SIR D'ARCY POWER, K.B.E., LONDON.

XIV. WHEELHOUSE'S OPERATION.

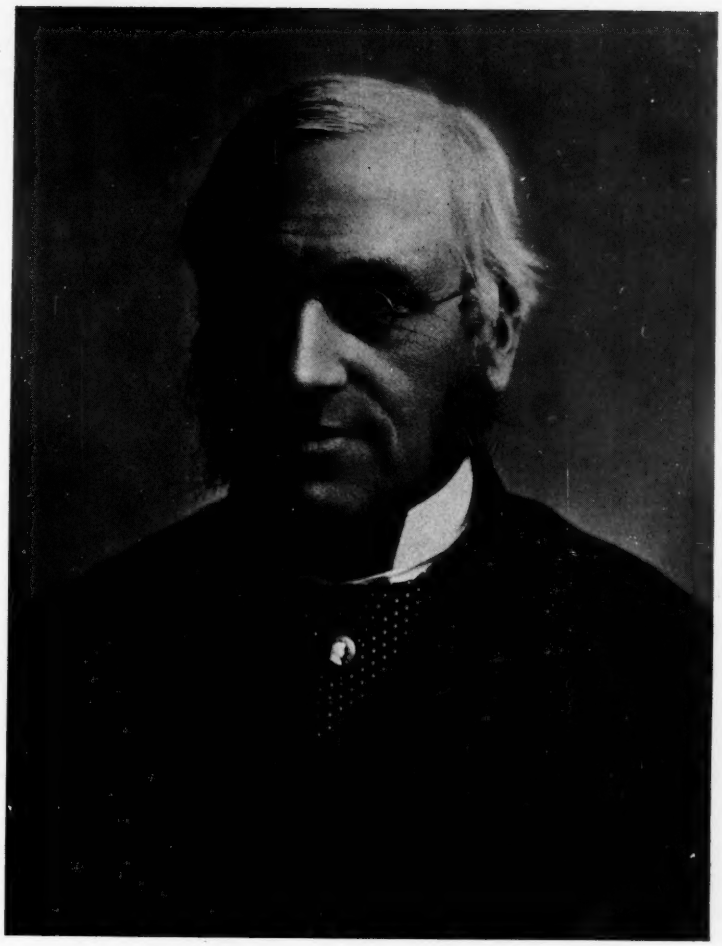
GONORRHŒA is a very old disease; from time to time our arboreal progenitors must have ruptured their urethras by carelessly falling astride of a branch; and the numerous operations for stone in the bladder in later days was followed by stricture of the urethra in a certain proportion of cases. Retention of urine is a troublesome condition, and its treatment is often urgent. The historical medical museums at Naples and in London show that catheters were an early invention, but surgical literature proves that the morbid anatomy of stricture was ill-understood. Galen seems to have thought that it was due to ulceration of the bladder; later opinion placed the seat of ulceration at the neck of the bladder or in the prostatic portion of the urethra, and throughout the middle ages retention of urine was stated to be caused by 'polypi' or 'caruncles' in the urethral canal; only lately has the real pathology of stricture been correctly explained. The treatment of the slighter forms of stricture has never presented much difficulty, but impervious strictures were a real bugbear to the older surgeons. Some confessed frankly that nothing could be done, and left the patient to Nature, hoping that the urine would become extravasated; others, bolder, used caustics of lime or arsenic to destroy the 'caruncles'; a few, like Ambroise Paré and Amussat, devised cutting probes with which they performed internal urethrotomy.

Astruc, who wrote a most useful and instructive history of venereal disease, says in 1736, after discussing the causes and treatment of urethral stricture, "But if no sort of catheter can be introduced there is only one method left of preserving the patient: to wit, to pass a trocar through the wound in the perineum directly into the bladder according to the known direction of the urethra, and by this means draw off the urine. We do not deny that the instrument in this operation deviates from the natural duct of the urethra, and wounds its coats in passing into the bladder. But what then? In the present danger of death it is better to try a doubtful remedy than none; neither are wounds of the urethra of such a nature that they will not admit of a cure. But as in former cases so in this, a pipe must

be kept in the bladder till there is a free passage through the urethra and the tone of the bladder is perfectly restored; and lastly, the pipe being drawn out, the wounds of the urethra are to be cleansed, carnified, and cicatrized according to the rules of our art." Astruc's treatment was followed for many years, though it was modified by Edward Cock, surgeon to Guy's Hospital, who published in 1852, in the *Transactions* of the Medical and Chirurgical Society, his paper on forty cases of retention of urine in which the bladder was punctured through the rectum.

In 1844 Professor Syme, of Edinburgh, published an account of his method of treating obstinate strictures of the urethra by external urethrotomy. He passed a small grooved director not exceeding in size the largest knitting-needle which could be passed through the stricture; cut down upon it through the perineum, and thus divided the stricture. The disadvantage of Syme's operation lay in the fact that it was unsuitable for impermeable strictures, as a filiform staff had first to be passed; but it was largely used for many years.

Mr. Claudius Galen Wheelhouse published part of a clinical lecture in the *British Medical Journal* for Feb. 5, 1870. The lecture was given in the Leeds School of Medicine upon two patients with impermeable stricture of the urethra, and in it he pointed out the advantage of using a grooved lithotomy staff rather than a sound or catheter in performing external urethrotomy. He also laid stress upon the advisability of opening the healthy urethra in front of the stricture, instead of cutting down upon the stricture itself as was done by Syme. He then went on to say: "I next seize with artery forceps each lip of the opening I have made into the urethra, and with these draw upon the canal, carefully assuring myself that the mucous membrane is included. The position of the staff is next completely altered. Taking it in my own hand, I reverse it, turn the point out through the opening I have made, and use it to draw forward, fix, and steady the urethra. If the parts are now carefully sponged, I have the interior of the canal so fully exposed to view that I can steadily follow its upper wall; this I do with a fine probe-director until I have cut my way completely through the stricture, and have come out into the dilated part of the urethra, which usually lies behind it, or, as sometimes happens, into a second or more strictures; this effected, I am generally able to pass the small director which I have been using immediately onwards into the bladder. Now, at this point I have seen the most skilful operators completely baffled; and although they have succeeded in effecting the division of the stricture most perfectly, I have known them fail entirely in their attempts to carry the catheter onwards into the bladder. Without a guide it is often a most perplexing and difficult matter to find the opening into the posterior portion of the urethra, or, when this is found, to insinuate the catheter into it by the side of the director; and it is precisely at this point that my little grooved director becomes of all important service. Having reached the bladder with that, I turn the groove downwards; with a straight probe-pointed bistoury run along it, I make sure of the division of any further obstructing bands, and finally I completely open up the prostatic urethra by sliding along the groove of the director the little instrument which I now show you, the 'probe-dilator', an instrument introduced by the late Mr. Teale



CLAUDIUS GALEN WHEELHOUSE

(1801–1867) for use in lithotomy, and thus obtain a broad metallic floor upon which I can, without any danger of failure, introduce a catheter of even the largest size."

It will be seen that this lecture contains the essence of an operation which Mr. Wheelhouse afterwards standardized, and which has since come into very general use.

It was some years before the advantages of the operation were recognized. Writing to the *British Medical Journal* on June 24, 1876, Mr. Wheelhouse says: "Notwithstanding the length of time that has elapsed since I brought

FIG. 151.

before the profession my method of finding my way in cases of impermeable stricture from the perineum, *through* the stricture and into the bladder, the subject seems to have received so little notice that I deem it advisable once more, after several years of successful employment of the operation, to revert to the subject. The instruments required are as follows: lithotomy bandages; a special staff fully grooved through the greater part, but not through the whole of its extent, the last half-inch of the groove being 'stopped', and terminating in a rounded button-like end (*Fig.* 151); an ordinary scalpel; two pairs of straight-bladed forceps, nibbed at the points; ordinary artery forceps and ligatures; sponge; a well-grooved and finely probe-pointed director; Teale's probe-gorget (*Fig.* 152);* a straight probe-pointed bistoury; a short silver catheter (No. 10 or 11 gauge) with elastic tube attached." The details of the operation are then given, and they do not differ materially from those previously described, though it may be noticed that as a result of further experience Mr. Wheelhouse had replaced the lithotomy staff which he used originally by a specially designed straight staff, and the curved by a straight catheter.

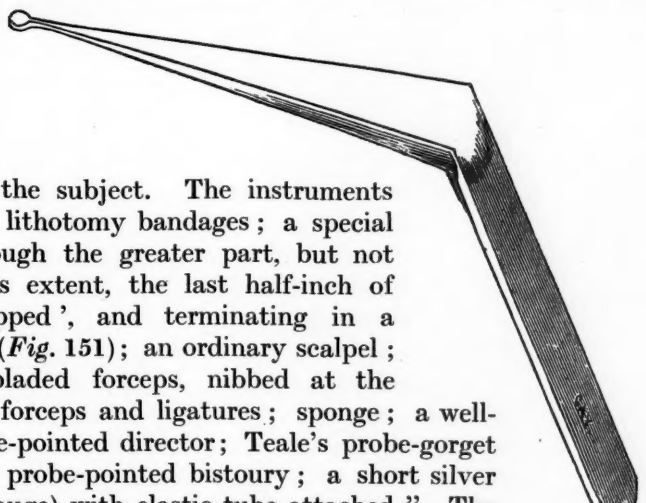


FIG. 152.

Claudius Galen Wheelhouse was born at Snaith, in Yorkshire, on Dec. 29, 1826, and died at Filey on April 9, 1909. He was the second son of James Wheelhouse, a surgeon, and was educated at the Bluecoat School in London. He was apprenticed at the age of sixteen to R. C. Ward, of Ollerton, Newark, and entered the Leeds School of Medicine in October, 1846. He qualified M.R.C.S.Eng. in 1849, and L.S.A. in the following year. He then went to the Mediterranean on a yachting cruise as surgeon to Lord Lincoln, afterwards fifth Duke of Newcastle and Secretary of State for War. He took with

* Figures 151, 152 are reproduced from the *British Medical Journal*, June 14, 1876.

him one of the first photographic cameras which left England, and obtained many good photographs in spite of the cumbrous processes then in use.

Returning to England in 1851 he entered into partnership with Joseph Prince Garlick, of Park Row, Leeds, the senior surgeon to the dispensary and lecturer on surgery at the Leeds School of Medicine. In the same year he was elected surgeon to the Public Dispensary and demonstrator of anatomy in the Medical School, where he was successively lecturer on anatomy, physiology, and surgery. He was twice President of the School, and when the new University of Leeds was inaugurated in October, 1904, Wheelhouse was made an honorary D.Sc. He served on the Council of the Royal College of Surgeons of England from 1876 to 1881, and presided at the Leeds meeting of the British Medical Association in 1889. He was also an elected representative of the medical profession upon the General Medical Council from 1886 until 1896.

The portrait is from a photograph kindly lent by S. F. Cowell, Esq., M.A., Secretary of the Royal College of Surgeons of England.

THE SECTIONAL PLASTER-OF-PARIS CASING WITH REFERENCE TO THE TREATMENT OF FRACTURES OF THE LEG AND ANKLE: CASE REPORT.

By W. A. COCHRANE, Edinburgh.

The criterion of function as the standard for judging the end-results of fractures is of great significance with regard to those of the leg, ankle, and foot. The deliberations of such bodies as the Fracture Committee of the British Medical Association in 1914 emphasize its importance especially in respect of the restoration of anatomic alinement. The Committee concludes that no method of treatment should be adopted which does not secure restoration and maintenance of anatomic alinement. Consideration of fractures in the region of the ankle demonstrates that in them, as in all articular and para-articular fractures, the effect of the injury upon the neighbouring joint is of greater importance functionally than the effect upon the bone itself. Restoration of anatomic alinement is necessary if the axes of the joint are to be correct as to their line of action and to the proper functioning of the tendons acting on and over it. P. D. Wilson, of Boston, has formulated the following rules as fundamental in the treatment of fractures of the ankle and of the bones of the leg:—

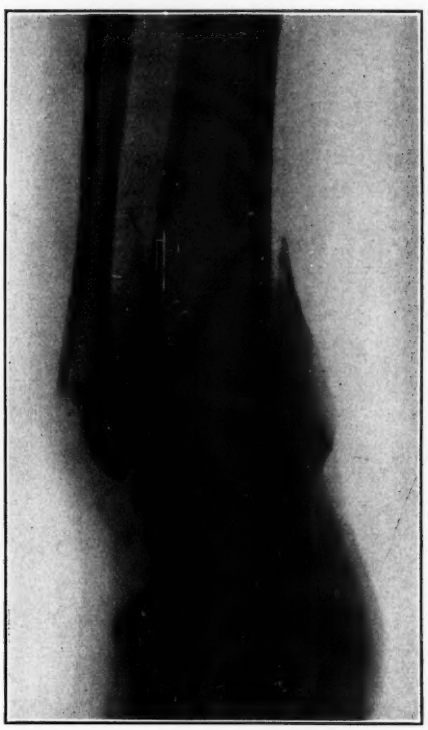


Fig. 153.—Antero-posterior skiagram of fracture-dislocation of the ankle. The foot and the malleoli have been displaced mesially in relation to the bones of the leg.

1. Complete anatomic reposition should be the goal in all cases, but slight displacement is not incompatible with good function, provided that the axes of the main fragments of the tibia remain parallel, and the tibio-astragaloid joint lies in the normal horizontal plane. In general, angular deformity is more to be feared than any other type of displacement.

2. When rigid dressings are necessary, care should be taken to fix the foot and ankle in the position of optimum function, that is, with the ankle at right-angle flexion, the foot inverted, and the arches supported.

3. The fundamental supporting structures of the foot being muscular,

it is of the utmost importance to preserve their tone and strength by beginning massage and active movement at as early a date as possible.

4. When weight-bearing is first permitted, the foot being weak, a certain amount of support should be provided by the use of a heel whose inner border is elevated. This slightly inverts the foot and holds it in a position of strength. Unprotected weight-bearing should not be permitted until the muscular function is good.

A large majority of fractures of the bones of the leg, and nearly all fractures and fracture-dislocations of the ankle, may be successfully treated by immediate reduction of the displacement under an anæsthetic, followed by immobilization in a plaster-of-Paris casing. With regard to fractures of the bones of the leg, simple fractures with displacement which are more or less transverse and are uncomminuted, come into this category. In those which are compound, comminuted, and are oblique or spiral in direction, traction methods or operation are best. It is the first group that is considered in this communication. The casing may be bivalved at once, and massage begun on the foot and leg as they lie in the posterior section of the casing. In a large series of cases, observed or treated by the writer, no interference with the circulation has taken place; although, in point of fact, the bivalving of the casing would help to prevent it. Nor has it been his experience that these fractures are usually associated with swelling, such as the books describe, sufficient to contra-indicate the use of plaster-of-Paris. It is fears such as these, which have no foundation in fact when the plaster is carefully applied, that, in the writer's opinion, have militated against the more general employment of the very best retention means at our disposal in certain fractures.

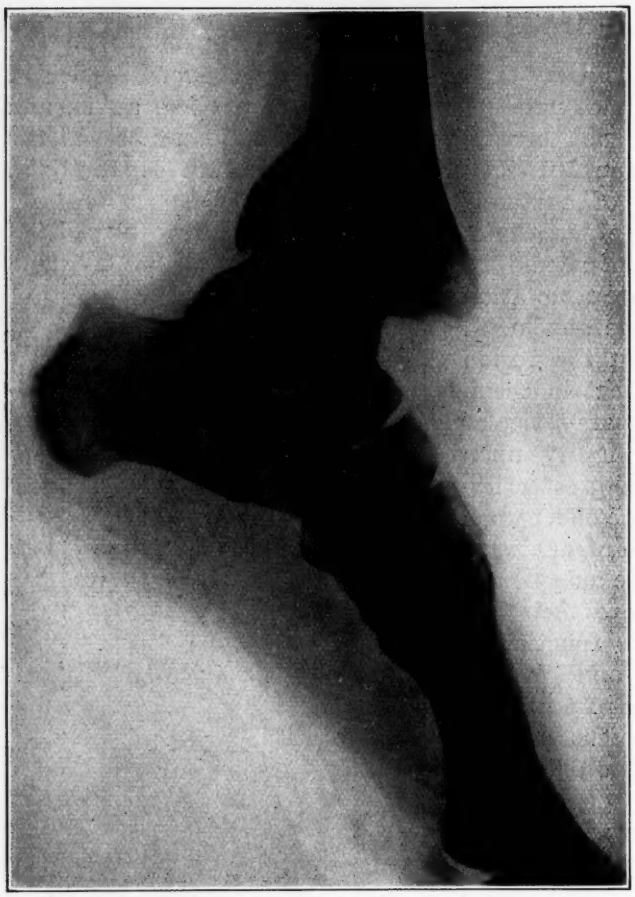


FIG. 154.—Lateral skiagram of the same: it shows the posterior dislocation of the ankle, and the fact that the malleoli are also displaced backwards.

The main difficulty in fractures of the leg and ankle lies, however, not in the actual reduction of the displacement, provided an anæsthetic is employed, but in the maintenance of the corrected position while immobilization, whether by splint or by plaster, is being secured. The ordinary means of splintage, as in the use of the box-splint or in the special splints which have been devised from time to time, are too haphazard in this respect. While one of these means is being employed, the fracture redisplaces, or does so subsequent to the patient's return to bed. All the work of reduction and the risk of the anæsthetic go for nothing, and the patient is in the unfortunate position of having to subject himself to another attempt at reduction, with the certainty of the same thing happening again. " But ", someone will say, " such a case should be treated by other means, by operation, say, or by traction in a Thomas's splint ". Such a reply, in the writer's opinion, simply begs the whole question of the possibility of treating the large group of cases referred to by the reduction and fixation method. Further, there is no question, in the case reported here, that treatment by operation or by traction could not have fulfilled the demands of the case.

It is with the main object of demonstrating that a precise, simple, and eminently practical method is available for such cases as are difficult to hold while fixation is being applied, that this communication is made. It involves the employment of a plaster-of-Paris casing applied in sections.

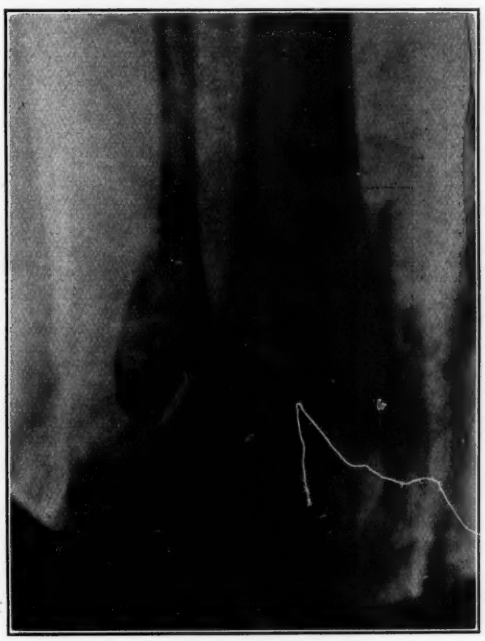


FIG. 155.—Over-correction of the mesial displacement of foot and malleoli.

CASE REPORT.

The following case, a fracture-dislocation of the ankle, is therefore reported at this time, as being of special clinical interest and importance with reference to the success which attended the use of a special method—a plaster-of-Paris casing applied in sections—in securing and maintaining reduction in a difficult class of case which had resisted the methods of reduction and immobilization commonly employed.

The patient, a middle-aged adult, was admitted to hospital on Jan. 16, 1924, with a simple fracture-dislocation of the right ankle, sustained in a street accident. She was knocked down by a motor cycle, the foot being caught and twisted by the machine. Clinically, there was present gross backward and inward displacement of the foot in relation to the leg. There was very little swelling. The antero-posterior skiagram (*Fig.* 153) revealed a fracture

through the base of both malleoli, with mesial displacement of the foot and malleoli. The lateral skiagram (*Fig.* 154) showed a complete posterior dislocation of the ankle, with posterior displacement of the malleoli.

Under the anæsthetic, reduction in both planes was obtained without much difficulty. The fact that the bony points about the foot and ankle were restored to the normal, and that the foot could be dorsiflexed beyond the right angle, was proof of this. As soon as support was altered or removed in the slightest degree, however, it was evident that the posterior dislocation

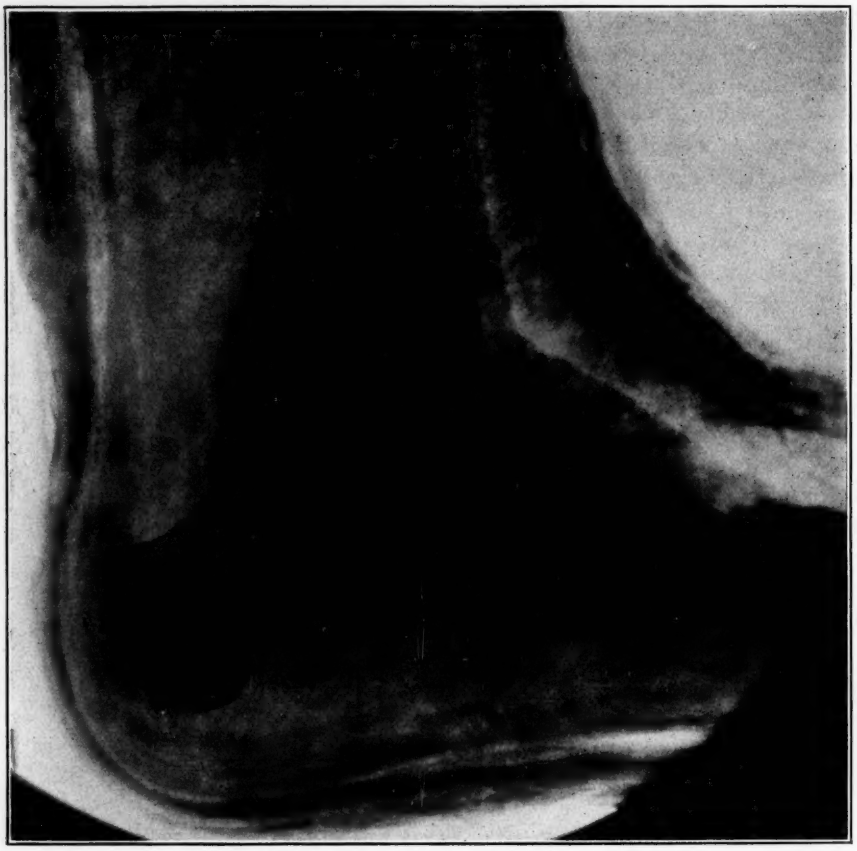


FIG. 156.—Profile view taken through plaster casing shows that the posterior dislocation has not been reduced.

recurred with the greatest ease. The extensive tearing of the ligaments was responsible in part, but a factor of greater importance, doubtless, lay in the loss of support to the astragalus normally provided by the malleoli when intact. Reduction being effected once more, the limb was encased in plaster-of-Paris from the toes to the middle of the thigh, with the knee flexed 30 degrees. Every effort was made to prevent recurrence of the dislocation while this was being done. The subsequent skiagrams (*Figs.* 155 and 156) showed, however, that while the displacement mesially had been over-corrected, the posterior dislocation was still unreduced. What had happened was that, in

making way for the turns of the plaster bandage, a momentary slackening of the hold, or an alteration in the position of the surgeon's hands, had allowed the corrected position to be lost, and that in spite of one's appreciation of its imminence. The writer felt that he was not justified in subjecting the patient to a second attempt at reduction unless a method or device more accurate and precise was available. It was desirable that a method should be adopted which would guarantee that, having secured reduction, it would not be lost again by the surgeon's hands requiring to alter their position, even momentarily, while immobilization was being secured in a plaster-of-Paris casing. As has been pointed out above, that is the crux of the whole question in such cases.

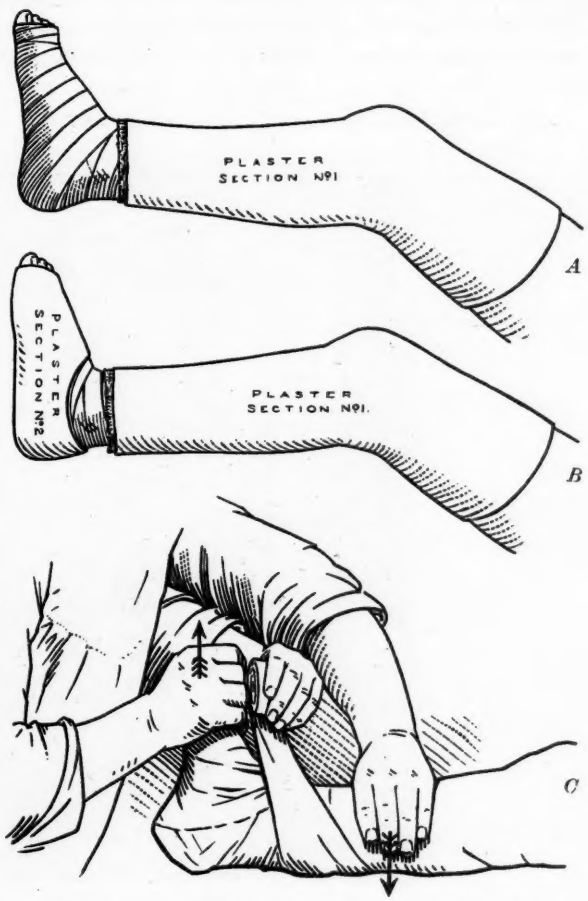


FIG. 157.—Illustrating the three-piece sectional plaster-of-Paris casing. *A*, Drawing from a photograph, showing the first section of the plaster casing applied. Note the projecting edge of the cuff of felt referred to in the text. *B*, Nos. 1 and 2 sections of the sectional plaster, leaving the region of the ankle free. *C*, Drawing from a photograph to show how reduction of the posterior fracture-dislocation is effected. Note that the foot is fully dorsiflexed and slightly inverted.

The Three-piece Sectional Plaster-of-Paris Casing.—A little thought suggested the idea that such a method was available and practicable, if the principles underlying the employment of a plaster-of-Paris casing, put on in two or more sections, as is done in orthopædic surgery, could be adapted to the fracture-dislocation in question. It was evident, then, that if separate plaster casings were applied, and allowed to set, above and below the area involved—in this case the ankle—so leaving it free for manipulation, the surgeon could correct the dislocation vigorously, and his assistant unite the two plasters by a third plaster bandage. The surgeon's hands would be out of the way of the turns of the third bandage as they were being applied, and therefore there would be no question of his hands requiring to alter their force or position meanwhile.

The first casing was removed. All swelling had subsided. An anæsthetic was administered, and over stockinette and woollen bandages the first section of the plaster was applied from a point two finger-breadths above the level

of the ankle-joint to the mid-thigh. Care was taken to encircle the leg just above the ankle with a cuff of sterilized felt, 4 in. broad, to take the backward pressure to be borne by this part of the anterior aspect of the leg in reducing the dislocation. The knee was flexed 30 degrees to relax the calf muscles and so allow of free dorsiflexion of the foot in the final position (*Fig.* 157, *A*). The heel being protected with a square of white felt, a second section of the plaster encased the foot, and was moulded by the hands to support the arches. This left the ankle free of plaster and ready for manipulation (*Fig.* 157, *B*). The two sections were allowed to set, and then the edges were trimmed and everted to avoid risk of pressure by them upon

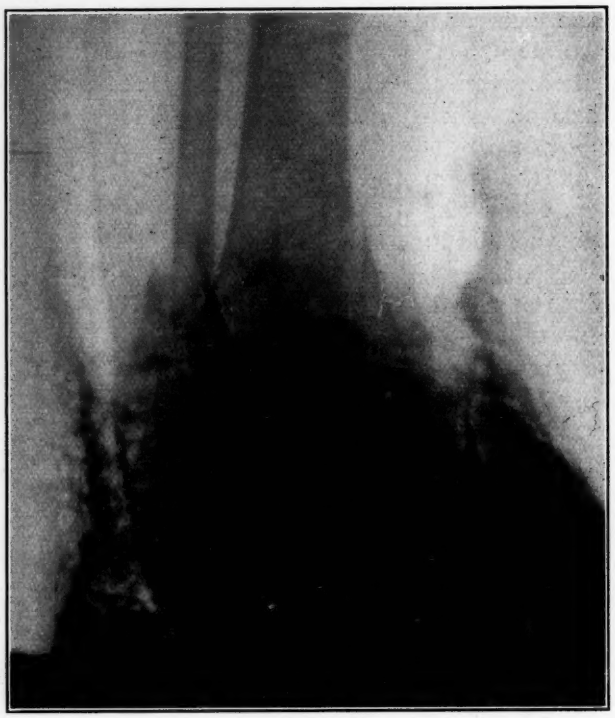


FIG. 158.—Antero-posterior view after treatment by sectional casing.

the soft parts in the final position of correction. The manipulation to secure reduction of the posterior dislocation was then made by pressing backwards with the flat of the left hand on the anterior aspect of the lower end of the first-applied cast, while the right hand seized the plaster encasing the foot and pulled it forwards vigorously (*Fig.* 157, *C*). Reduction was felt to take place quite easily, as before. The foot being fully dorsiflexed and in slight inversion, it was possible for the surgeon to maintain the reduction strongly and with absolute certainty, while an assistant united the two plasters by a few turns of a plaster bandage. In this way the third and last section was applied and the casing completed (*Fig.* 157, *C*). The whole point in the rationale of the scheme lay, then, in the fact that, once reduction was

effected, it was never again in jeopardy or exposed to the risk of redisplacement.

Subsequent skiagrams (*Figs.* 158 and 159) showed that reduction in both planes had been secured. The limb was immobilized in the original plaster for six weeks to allow the malleoli to unite and the torn ligaments to heal. On lifting the limb from the splint, the patient had immediate power of moving the foot and ankle to quite an appreciable degree, and with massage the range of active motion is steadily increasing. The final result promises well as to ultimate function.

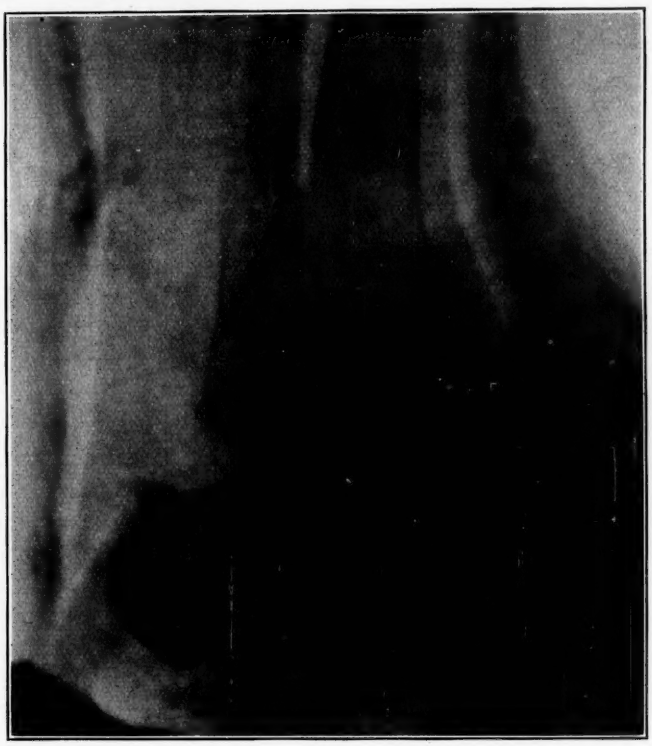


FIG. 159.—Lateral view of same.

The Three-piece Sectional Plaster of Fiske.—The device detailed above really represents an adaptation of the method of Fiske, of Chicago, in his treatment of congenital club-foot by a three-piece plaster-of-Paris casing. It was from having used Fiske's technique in such cases that the idea occurred to the writer that it might be adapted as a practical solution of the problem presented. In the case of congenital club-foot, Fiske pointed out that the various deformities were best corrected slowly in a plaster casing applied in sections, over stockinette made to adhere to the leg and foot by Sinclair's glue. A plaster-of-Paris casing is applied to the foot itself below the malleoli, suitably protecting the bony points with tiny squares of white felt. As the plaster sets, the surgeon seats himself opposite the child, who

is seated on his mother's knee, and moulds it carefully to secure correction of the flexion of the toes, the adduction of the foot, and the mesial tilting of the os calcis. These three deformities are all located in the foot itself. There remain three deformities of the foot in relation to the leg, namely, equinus, inversion, and internal rotation. The second plaster is therefore applied to the leg from a point just below the knee to a point just proximal to the ankle-joint. When it has hardened, foot and leg are grasped, and the former is brought gently into a position of dorsiflexion, eversion, and external rotation. The assistant then joins the two plasters by a third, and so completes the casing. *Fig.* 160 represents the end-result of a typical case after nine months' treatment and four successive plasters. The method does not require an anæsthetic, is not forcible, and functionally gives the best results possible.

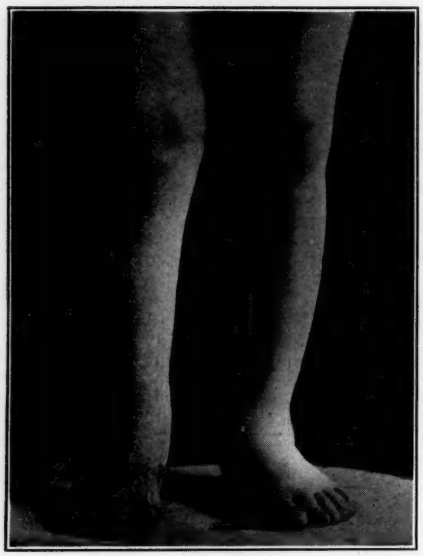


FIG. 160.—Final result in a case of congenital club-foot treated by the three-piece sectional plaster technique of Fiske. Full voluntary over-correction is possible. A supplemental operation was necessary in this case.

The Sectional Plaster in Fractures of the Bones of the Leg.—The writer owes to his association with Dr. P. D. Wilson, of Boston, instruction in a method used extensively by the latter in the Fracture Service of the Massachusetts General Hospital, and which the writer has employed since (*Fig.* 161). The patient is anæsthetized and placed on his back on a firm table with the buttocks resting on the edge. The uninjured leg rests on a chair, while an assistant holds the fractured leg. The foot and ankle of the fractured leg are now encased in stockinette and woollen roller bandages. The foot and ankle are padded with an anklet of thick felt, and a piece of strong bandage, 10 feet long, is tied over the anklet as a clove-hitch, leaving the ends long. The loose ends are knotted around the hips of the assistant, so that, by leaning backwards, he may exert traction on the leg, while his hands are left free to support the foot. The knee is flexed to a right angle, and a wide bandage is made to encircle the thigh just above the knee. The ends, left long, are held by an assistant, who stands at the head of the table and exerts counter-traction. By this means, and by manipulation of the fracture itself, the fracture is reduced and the position maintained by the traction. The plaster casing is then applied in two sections. The first section extends from the ankle to the groin, and, when it has hardened, the ankle-sling is removed. The foot and ankle are then encased in a separate plaster and united to the first section. The foot is dorsiflexed and slightly inverted. Care must be taken not to include the traction-bands in the cast. The bandage round the thigh may be withdrawn in time, by not including it completely in the first instance, after which the gap is rapidly covered in by the plaster, and the assistant supports the knee and thigh manually.

It is a safe rule in all these cases to see the patient on the same day as that on which the cast is applied, and on the next day also. If any doubt exists as to the integrity of the circulation, the cast and its lining may be bivalved. In a large series of cases, the writer has seen no difficulty from this source, nor any untoward local pressure effects by the plaster.

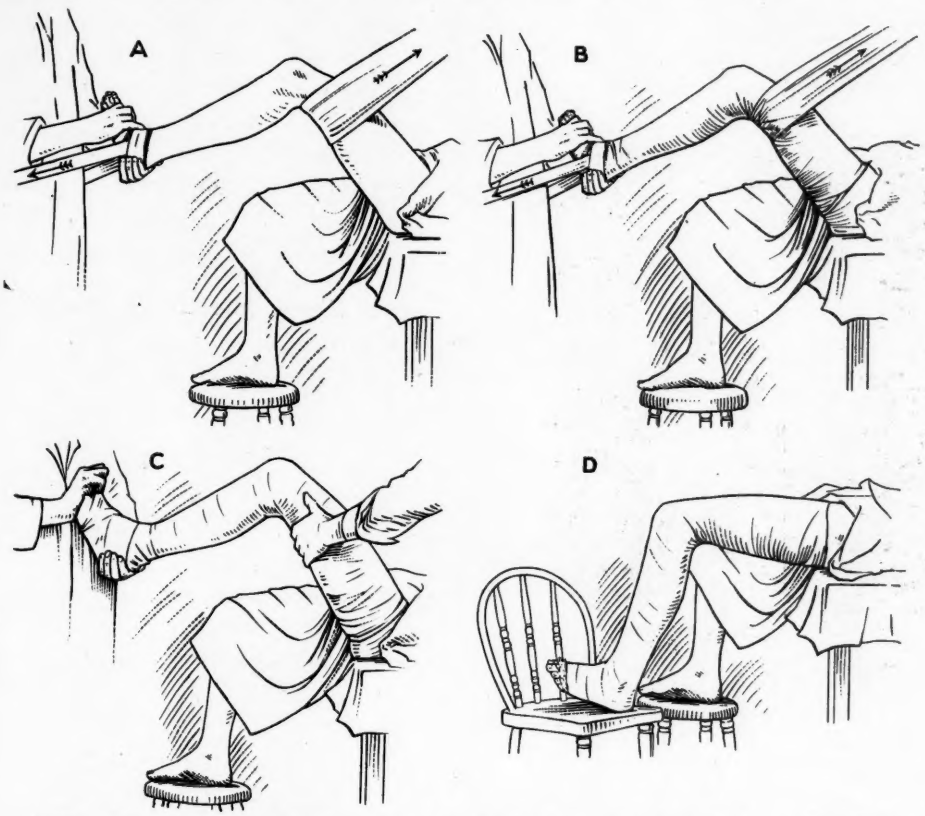


FIG. 161.—Reduction of a fracture of the leg by the traction method. A, Traction is obtained by passing a piece of bandage about the ankle in the form of a clove-hitch, a soft pad of felt being interposed between it and the skin. The ends of the bandage are knotted about the hips of an assistant, who supports the foot manually and exerts traction by inclining the body backwards. Counter-traction is obtained by a supporting band passing around the lower part of the thigh which holds the knee flexed. B, In this position a plaster casing is applied in sections. The first section extends from the ankle to the groin, space being allowed for the removal of the counter-traction band. C, When this has hardened, the traction bands are removed and the foot is supported manually while the remaining portion of the plaster is applied. D, Plaster completed.

The Process of 'Wedging' the Plaster Casing in the Correction of Residual Deformity.—Subsequent skiagrams are taken through the plaster. As a rule, the position is satisfactory, but, should some angular deformity exist, it is possible to correct it by a process of 'wedging' (*Fig.* 162). Opposite the site of fracture, the case is cut in a circular manner for three-quarters or a little more of its circumference, leaving it intact opposite the obtuse angle of the angulation deformity. Using this intact portion as a hinge, it is possible to bend the cast in the appropriate manner necessary for the correction of the angulation. In doing so, the edges of the cleft in

the plaster are separated. To prevent their springing together again, little blocks of wood are put into the cleft, to maintain correction when the surgeon lets go his hold. The cast is then strengthened by a few turns of a plaster bandage. The principle of wedging is applicable to other fractures, notably in the forearm, as, indeed, is the principle of the sectional plaster.

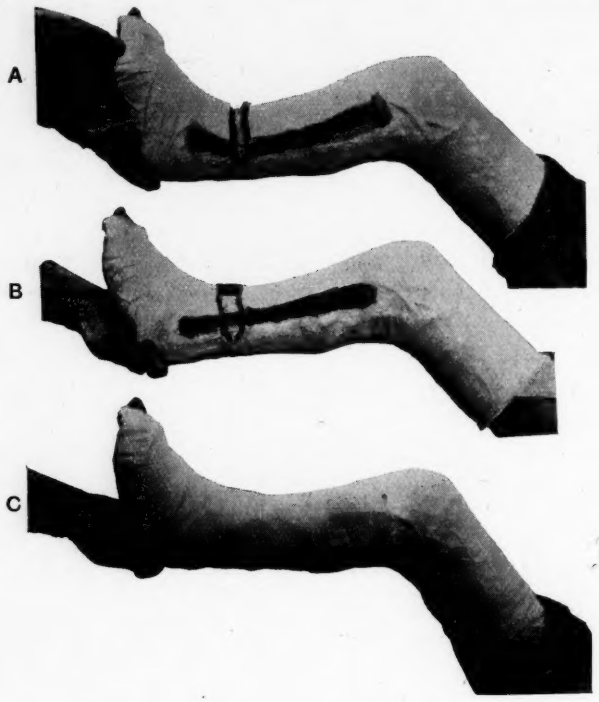


FIG. 162.—'Wedging' the plaster casing in correction of the residual deformity. A, The black line represents a fracture with posterior angulation. The cast has been cut in a circular fashion at the level of the fracture, leaving the casing intact posteriorly. B, The angulation has been corrected, and, to prevent recurrence of the angulation, little blocks of wood have been inserted to keep the edges of the cleft apart. C, A plaster bandage is then employed to cover in the whole, and the casing made complete again.

CONCLUSIONS.

1. In fractures of the bones of the leg and in the region of the ankle, restoration to the anatomic normal is especially essential for function.

2. A large majority of these cases may be successfully treated by immediate reduction and fixation.

3. A general anæsthetic should always be employed.

4. A plaster-of-Paris casing furnishes the best means at our disposal for securing immobilization. In a large series of cases the writer has seen no untoward circulatory or pressure effects from its careful and proper employment. In his opinion, the splints in common use for these cases should be discarded.

5. Fractures of the bones of the leg and fracture-dislocations of the

ankle present their main difficulty, not in the actual reduction of the fracture, but in the maintenance of the corrected position while immobilization is being secured.

6. The ordinary means of securing immobilization are too haphazard in this respect.

7. A precise, accurate, simple, and practicable method, in the form of a plaster-of-Paris casing applied in two or more sections, is available. The device is based upon the three-piece sectional plaster method employed by Fiske in the treatment of congenital club-foot.

8. The process of 'wedging' makes very fine adjustments possible, especially with reference to angular deformity.

9. In the writer's opinion and experience, the sectional plaster-of-Paris method should be the method of choice in all cases with displacement, where immediate reduction and fixation are indicated.

10. In the especially difficult case, such as here reported, it becomes the method of necessity, for neither traction methods nor operation would have been likely to succeed.

The writer is indebted to Professor Sir Harold J. Stiles for permission to report this case.

SQUAMOUS-CELLED CARCINOMA OF THE RENAL CALIX.

By GEOFFREY KEYNES, London.

Malignant growths of any part of the renal pelvis are stated to be rare, and up to the year 1922 only the comparatively small number of 56 cases had been recorded in the medical literature of the world.[1] The total has now been increased to 60 or more, one of the additions having been made in a recent number of this journal by Mr. Geoffrey Hadfield,[2] who recorded most of the known facts relative to the condition. A considerable proportion of these tumours are found to be associated with calculi, but it is not as a rule possible to determine whether the carcinoma preceded or followed the formation of the calculus. It has usually been assumed that the carcinoma was consequent on the irritation caused by the calculus, but this assumption is not justified in view of the fact that many more malignant growths occur in the absence of calculi than with them. Very few of the recorded renal carcinomata were, on the other hand, associated with a hydronephrosis. Whether or not the carcinomata were preceded by leucoplakia of the epithelium of the pelvis or by chronic ulceration is in most instances difficult or impossible to determine. Only a very close examination of the case histories could throw any light on this point.

The purpose of the present article is to record two remarkable instances of renal carcinoma. The first, which was associated with calculus and pyonephrosis, presents several points of interest, both clinical and pathological. The second was associated with a hydronephrosis of the congenital type, and is chiefly of pathological interest. The records of a third case have been added to the series, since it illustrates in a striking manner the possible origin of a carcinoma in the pelvis of a hydronephrotic kidney, both leucoplakia and chronic ulceration being present.

Case 1.—A bookbinder, age 35, had enjoyed good health until the end of September, 1920. He then began to suffer from pain in the right side of his abdomen, associated with the presence of blood in his urine. The pain was not severe, and his general health had remained good. There was no increased frequency of micturition. An abdominal operation had been performed in infancy, but for what disease could not be ascertained. Hæmaturia had been noticed on *one* occasion six years before.

The patient was admitted to St. Bartholomew's Hospital on Oct. 18, 1920. He appeared to be thin and somewhat anæmic, but said that this was his normal appearance, and would not admit to having been ill for more than about three weeks. On examination he was found to have a large, fluctuating tumour in the right loin. Cystoscopy showed a normal bladder, but a purulent efflux was seen to come from the right ureter. X-ray plates showed the presence of a large branched calculus in the pelvis of the right kidney, and a diagnosis of 'pyonephrosis with calculus' was made. On

Oct. 26 a right nephrectomy was performed by Mr. T. P. Dunhill, a greatly enlarged kidney being removed through the usual incision in the flank. Some adhesions, thought to be inflammatory, were encountered at the lower pole, but no great significance was attached to these. The kidney, when split open, presented the appearance shown in *Fig.* 163. Each lobulation corresponded to a dilated calix containing pus, and five of the calices contained calculi. Another large calculus occupied the pelvis of the kidney, and possessed a short 'beak' projecting into the ureter. The calices at the lower pole contained some blood-clot as well as pus. The kidney tissue appeared to be

FIG. 163.—*Case* 1. Kidney split open along its free border, showing calculi in pelvis and calices. The white area in the wall of the calix near the lower pole on the right side shows carcinoma in section. A, Carcinomatous area.

almost non-existent, the organ having been converted into a multiloculated cyst with fibrous walls. The original diagnosis seemed to be confirmed, and the prognosis was regarded as being favourable.

The patient's convalescence was normal, and the discharge from the wound had ceased by Nov. 8, thirteen days after the operation. He was sent to a convalescent home soon afterwards.

On Dec. 7 the patient returned to his own home, and on the following day he noticed a recurrence of the tumour in the right side of his abdomen. He was re-admitted to hospital on Dec. 16, and was then found to have a large

fluctuating swelling in the same situation as before. There was a small mass of 'granulations' at one end of the operation wound, which was again discharging some purulent fluid. On Dec. 17 the operation wound was partially re-opened, and about two pints of foul pus were evacuated. Following this, the supposed granulations on the surface increased rapidly in amount, and began to undergo a superficial necrosis. At the same time the abdominal swelling became larger, in spite of the drainage which had been established. A microscopic section from the granulations was made on Dec. 24, and cells resembling those of round- and spindle-celled sarcoma were seen. It was evident at this stage that the original diagnosis would have to be revised, and a further examination of the kidney, which had been sent to the hospital museum, was undertaken.

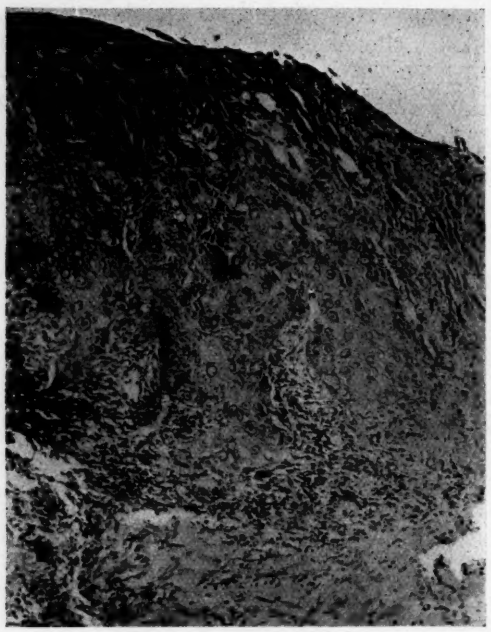


FIG. 164.—*Case* 1. Infiltration of the walls of the kidney with a squamous-celled carcinoma. The surface of the epithelium of the calix is showr at the top of the photograph (× 95).

It was now noticed that the wall of one of the calices in the lower

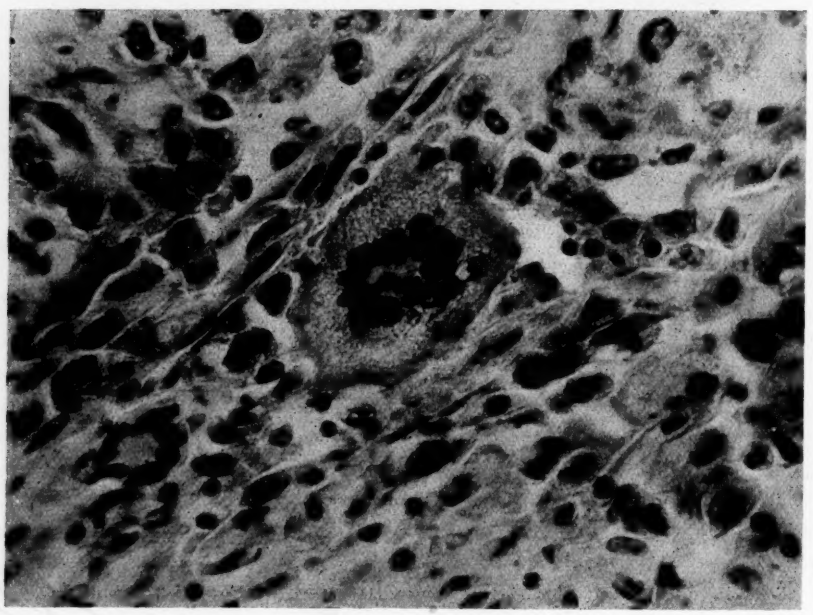


FIG. 165.—*Case* 1. Section of the growth immediately outside the kidney, showing metaplasia of the carcinoma cells, including giant-cell formation (× 540).

pole was thicker and of a whiter appearance than in the others (*Fig.* 163). Sections were made from this region, and it was found that no sarcoma cells were present, but that the wall of the calix was infiltrated with a typical squamous-celled carcinoma (*Fig.* 164). Immediately outside the kidney capsule the type of cell showed a considerable degree of alteration, even multinucleated giant cells being a feature of the growth in this situation (*Fig.* 165).

FIG. 166.—*Case* 1. Section of the recurrent growth in the flank (× 540).

Meanwhile the patient's condition became rapidly worse, and he died on Jan. 10, 1921, eleven weeks after the removal of his kidney. During the last fourteen days of his life the growth in his flank increased in size with extraordinary rapidity, and at his death a black, fungating mass nine inches in diameter projected from his flank for two inches beyond the surface of the skin. The intra-abdominal tumour was as large as a child's head.

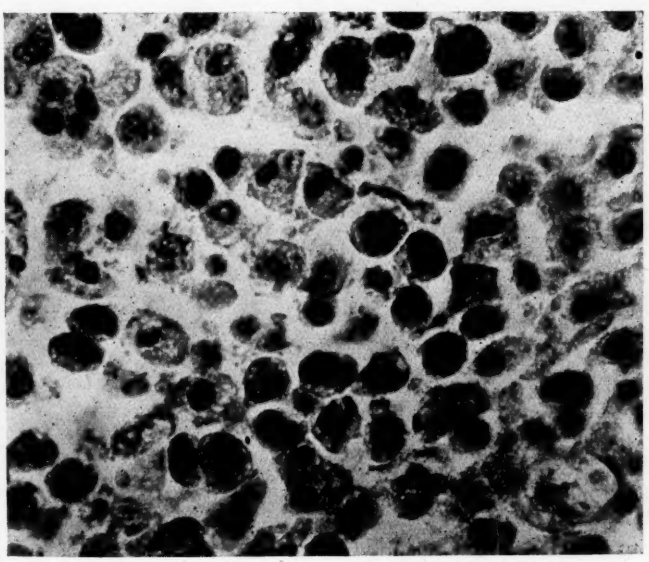


FIG. 167.—*Case* 1. Section of the metastatic growth in the heart (× 540).

At the autopsy very little of interest was found beyond the growth in the right flank already described. This was very soft and had become largely necrotic. The only metastasis that could be found was a lump the size of a marble in the muscle of the right ventricle of the heart. The patient's death was due primarily to cachexia and toxæmia.

Sections from the less necrotic parts of the growth showed an extreme degree of metaplasia of the cells, which, in the absence of other evidence, it would have been difficult to assign to their true origin (*Fig.* 166).

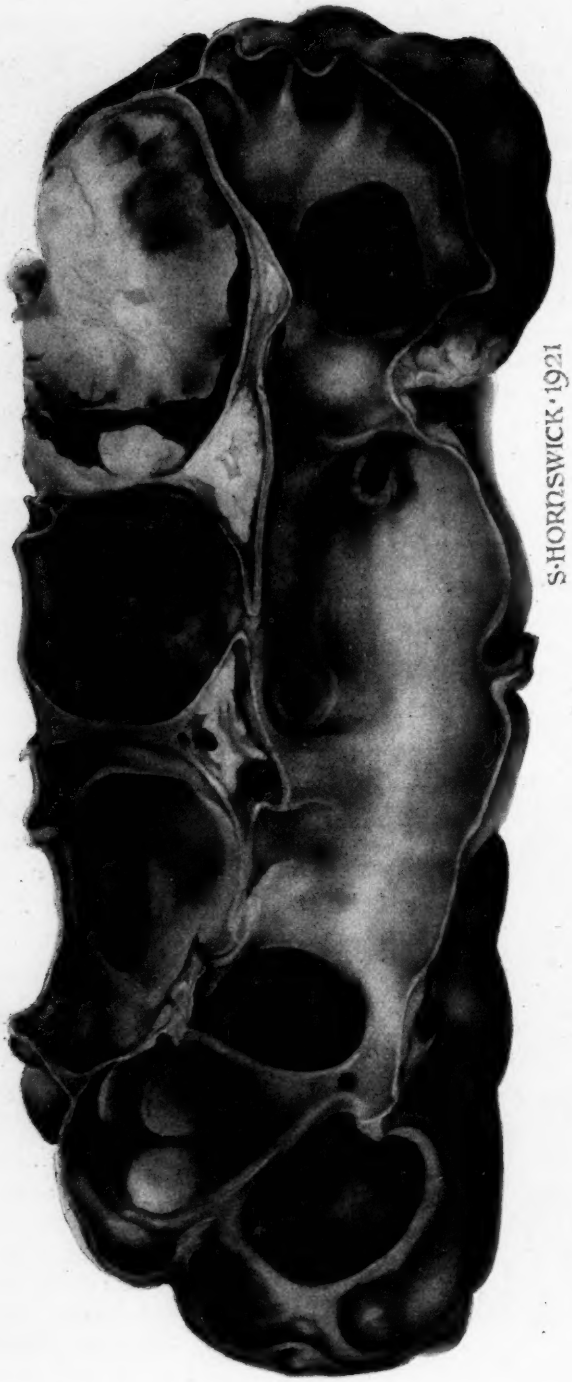


FIG. 168.—*Case* 2. Mesial section of the kidney, showing large malignant papilloma in a dilated calix near the lower pole.

These cells were of all shapes and sizes, and, but for the absence of any stroma, could not confidently have been designated carcinomatous. A section (*Fig.* 167) of the metastatic growth from the heart showed a more uniform type of cell, but the type was that of a more primitive, rounder cell than was found in the primary growth. In the luxuriant growth on the surface of the body the cells, as already described, had so far departed from their original form that they were believed to be sarcomatous. This observation suggests that some of the recorded cases of sarcoma of the kidney associated with calculus may have been in reality carcinomata, the primary lesion having been, as in the present instance, relatively inconspicuous.

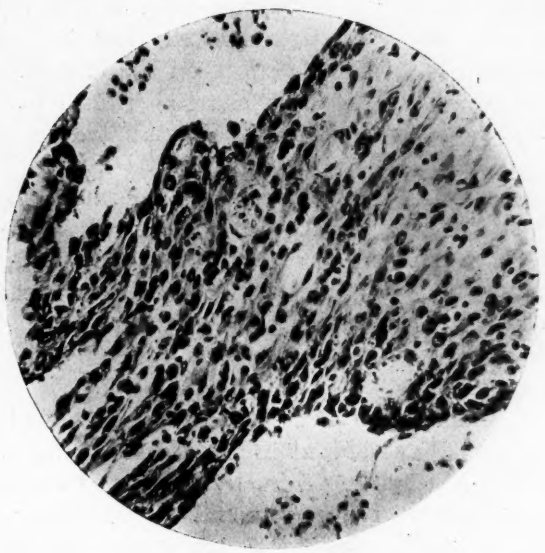


FIG. 169.—*Case* 2. Section of the base of the malignant papilloma of the renal calix (× 95).

CASE 2.—A night-watchman, age 54, had complained of no symptoms until May, 1921, when he noticed some blood in his urine. This was unaccompanied

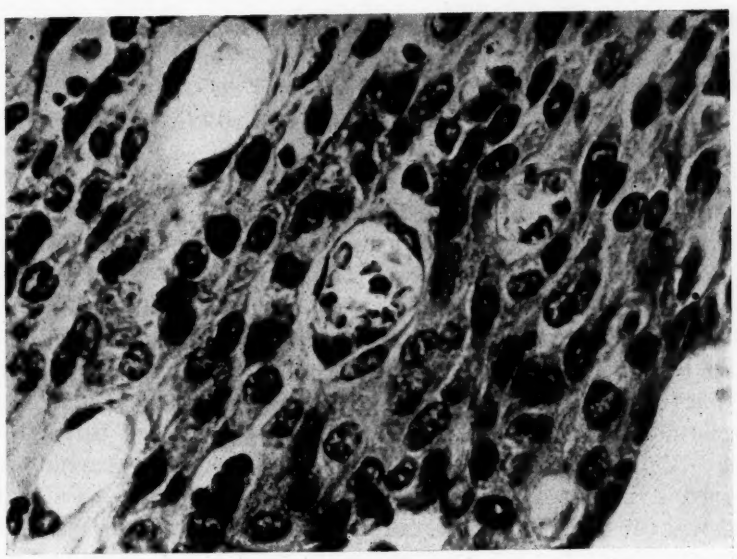


FIG. 170.—*Case* 2. Same as *Fig.* 169—higher power view (× 480).

by any pain, difficulty in micturition, or increased frequency. In June, 1921, the patient experienced attacks of severe pain in the lumbar region

on the right side. He came to hospital on account of pain, and was admitted on Aug. 15. He was then found to have a large, tense tumour in the left flank, which moved on respiration and was dull to percussion. His urine contained many pus-cells, a few red blood-cells, and many coliform bacilli. A cystoscopy showed that the efflux from the right kidney was normal, but that the efflux on the left side was very infrequent, and that no indigo-carmine was discharged from this side after intravenous injection. The blood-urea content was estimated to be 42 mgrm. per 100 c.c.

The left kidney was removed by Mr. T. P. Dunhill on Aug. 19, but not without difficulty, owing to its enormous size and to the presence of adhesions near the lower pole. The patient made an uninterrupted recovery, and was discharged from hospital, apparently well, on Sept. 10, 1921. His further history is not known, and no reply was received to inquiries made on several occasions during the two following years. The condition found on examination of the specimen makes it probable that he did not survive his operation for long.

The kidney which had been removed was very greatly distended, the cortex being reduced to a thin shell (*Fig.* 168). The pelvis was also greatly dilated, measuring 4 in. by 3 in., and its wall was hypertrophied. For some thirty minutes after removal of the kidney, any stimulus applied to the wall of the pelvis initiated a strong wave of contraction, which spread round the whole pelvis and culminated at the ureteric orifice. The ureteric orifice was small, but the ureter itself appeared to be normal. The gigantic pelvis, as seen in the figure, communicated through a number of holes with greatly dilated calices. These were filled with blood-clot, and in the biggest, situated in the lower pole, was a large papillomatous growth, surrounded by several smaller ones. The capsule of the kidney was missing over the area corresponding to these growths, the wall of the kidney having been adherent to neighbouring structures. Sections through the bases of these growths showed infiltration by cells of transitional epithelium, which had no tendency to keratinize (*Figs.* 169, 170).

In this case, therefore, there was a papillary squamous-celled carcinoma growing in the calix of a kidney affected by hydronephrosis of the congenital type. The ureter was normal, and no aberrant vessel was found obstructing the outflow of urine. Muscular co-ordination was seen to be normal in the renal pelvis, and it seems necessary, therefore, to postulate incomplete relaxation of the ureter itself in order to account for the condition. Whatever the cause of the hydronephrosis may have been, it had evidently been present for many years before the development of the carcinoma, which seemed only recently to have infiltrated through the wall of the kidney to the surface.

Case 3.—A milk carrier, age 20, had complained of recurrent attacks of pain in his back in the left renal angle, accompanied by hæmaturia. The first attack was in March, 1923, and he had three or four similar attacks during the year. The patient was in severe pain when admitted to hospital on March 7, 1924. His urine contained much blood, and was found to be infected with a coliform bacillus. The left kidney could be felt to be somewhat enlarged, but was not tender. The mucous membrane round the left ureteric orifice was seen to be œdematous. Other investigations led to a tentative

diagnosis of hydronephrosis with hæmaturia being made, and the left kidney was removed by Mr. T. P. Dunhill on March 21.

Both the kidney and the pelvis were much enlarged, the wall of the pelvis being also hypertrophied (*Fig.* 171). The ureter had very much thickened walls, and the lumen was very narrow at the upper end. In the upper part of the pelvis were two chronic ulcers, the larger one being covered with a layer of fibrinous material. A considerable area of the rest of the pelvis was of an opaque whitish colour, apparently due to an early stage of leucoplakia. No abnormal renal artery was found, so that the kidney appeared to be in an earlier stage of the same condition as was found in *Case* 2. Hæmaturia is a not infrequent sign of hydronephrosis even in the absence of any ulceration, though it is not always mentioned in the published accounts of the disease. The patient in the present case was young, but had he not had severe pain as a symptom it seems probable that the lapse of another thirty years might have resulted in the production of a kidney resembling that of *Case* 2.

FIG. 171.—*Case* 3. Mesial section of kidney, showing chronic ulcers in upper part of dilated pelvis and early leucoplakia in the lower part.

All three patients were in the wards of the Surgical Professorial Unit, St. Bartholomew's Hospital, under Professor G. E. Gask, who has kindly allowed the cases to be published. The specimens here described are now all in the museum of the Hospital.

The microphotographs illustrating this article have been made by Miss M. Vaughan, Dunn Laboratory, St. Bartholomew's Hospital.

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[1] DARNALL, W. E., *Surg. Gynecol. and Obst.*, 1922, xxxv, 493.
[2] HADFIELD, G., *Brit. Jour. Surg.*, 1924, xi, 583.

SOME OBSERVATIONS ON THE PROGNOSIS IN ACUTE APPENDICITIS.

By R. J. McNEILL LOVE, London.

Having recently analysed and published in the British Journal of Surgery (April, 1923) the result of operations for acute appendicitis at the London Hospital for three years, 1920–22, it appeared that a fuller analysis might reveal some further points of interest; and in order to acquire further data I have included cases of acute appendicitis operated on during 1923—making a total of 2018 cases.*

Table A.—Prognosis Regarding Local Conditions.

Group I.—Cases operated on *within twenty-four hours* of onset.

No. of Cases	Recovered	Died	Mortality
			Per cent
221	219	2	0·9

Group II.—Cases treated on *delayed* lines.

	No. of Cases	Recovered	Died	Mortality
				Per cent
Inflammation subsided ..	232	227	5	2·1
Unsuccessfully delayed ..	109	102	7	6·4
Total	341	329	12	3·5

Group III.—Cases in which *immediate operation* was performed (including *Group I*).

Condition present at Operation	No. of Cases	Recovered	Died	Mortality
				Per cent
Inflammation limited to the appendix	633	627	6	0·9
Local peritonitis ..	467	438	29	6·2
Local abscess	347	331	16	4·6
General peritonitis ..	230	183	47	20·5
Total	1677	1579	98	5·8

In my previous article I attempted to elucidate replies to two questions—

* I am indebted to the surgeons of the London Hospital for permission to include in the above series cases which were under their treatment or observation.

"When to operate" and "The best route for drainage". In this paper I propose to consider the prognosis of acute appendicitis with regard to local conditions present at operation, the duration of the attack, and the age of the patient, and I have summarized complications which occurred in this series of cases. The analysis of these groups gives additional support to those who advocate that the treatment of cases of acute appendicitis should receive individual consideration, in contradiction to the popular belief that all cases should be operated on as soon as diagnosed.

Local Conditions at Operation (*Table A*).—All surgeons are agreed that early cases of appendicitis should be operated on immediately while the infection is still limited to the appendix, that is, during the first twenty-four to thirty-six hours, or the period more accurately defined by the presence of a band of hyperæsthesia above Poupart's ligament, which denotes a distended and therefore intact appendix.

As seen in the above table, the lowest mortality (0·9 per cent) is naturally in cases operated on in this early stage. Then follows the quiescent group with a mortality of 2·1 per cent. This group consists of cases which had passed the period of safety and were then successfully tided over the acute period, and appendicectomy performed after inflammation had subsided. In addition to this, credit must also be given to the delayed treatment for converting many cases of local and general peritonitis into a localized abscess, which carries a lower mortality than either of these two antecedent conditions. Also, in comparing the mortality of *Groups II* and *III*, it must be noted that *Group III* includes *Group I*, i.e., 221 cases in which operation was performed within twenty-four hours. As the delayed group only consists of cases which have passed this early period, in order to obtain a true comparison of the mortality of immediate and delayed operations these early cases must also be excluded from *Group III*. We then find the mortality of cases in which immediate operation was performed is 6·6 per cent, compared with a mortality of 3·5 per cent in delayed cases.

Briefly outlined, the principles of delayed treatment, which were recommended by Sherren[1] as long ago as 1905, are as follows: If, after admission, it is decided that the appendix is perforated, local abscess is present, or general peritonitis has supervened, the patient is placed in Fowler's position, fomentations are applied to the abdomen to relieve pain, and only water is given by mouth. A four-hourly chart is kept, and over 70 per cent of cases subside, and permit of a subsequent clean appendicectomy. This is performed after the pulse and temperature have been normal for a week, or after the complete disappearance of local inflammatory swelling. This interval is usually within ten to fourteen days after admission, during which period the patient is given a fluid diet as soon as he desires such, and the bowels are only moved by an enema if indicated by abdominal discomfort. A word of caution is necessary with regard to the enema; rupture of an abscess has occurred from sudden distention of the lower bowel by a pint of soap and water; hence to reduce local disturbance to the minimum a small glycerin enema is given, which may be preceded by liquid paraffin by the mouth.

During the interval of delay, operation may be required for two reasons.

1. If after twenty-four hours of delayed treatment the pulse and

temperature show no indication to fall, or the patient complains of increasing pain or discomfort. This delay might be expected to influence the prognosis adversely; but figures show that such is not the case, the mortality being 6·6 per cent in cases operated upon immediately, and 6·4 per cent in the unsuccessfully delayed.

2. In certain cases a localized abscess forms which can be allowed to absorb in safety. Occasionally the abscess increases in size and causes marked toxæmic symptoms, in which case it is opened and drained in order to avoid rupture internally or on the surface. As it is very improbable that the appendix can be satisfactorily removed in the case of localized abscess, the drainage can be readily performed under nitrous oxide anæsthesia, and thus the risk and discomfort of the usual general anæsthetic avoided.

The local peritonitis group carries a relatively high mortality—6·2 per cent. Had treatment of this group been delayed, in all probability the majority of them would either have subsided or localized to form an abscess, and in either case the mortality would be substantially reduced.

Cases of general peritonitis subjected to surgical interference carry a notoriously high mortality; in 230 cases in this series the mortality was 20·5 per cent. Marsch,[2] in an analysis of 9000 cases, found that cases of general peritonitis carried a mortality of 17·5 per cent. Several factors combine to this end, probably the most important being the virulence of infection as compared with the patient's resistance, which is indicated pathologically by the inability of the tissues to form protective adhesions. Again, these cases are usually subjected to operation at the most inappropriate time, a factor which is discussed later.

Table B.—Mortality of Operation on the Different Days of the Attack.

No. of Days	Inflammation limited to Appendix		Local Peritonitis		Local Abscess		General Peritonitis		Total		Mortality
	Recov'd	Died	Recov'd	Died	Recov'd	Died	Recov'd	Died	Recov'd	Died	
											Per cent
1	191	1	52	1	20	0	16	1	279	3	1·1
2	264	2	61	2	45	2	69	7	439	13	2·8
3	82	2	79	12	123	8	72	19	356	41	10·3
4	21	0	67	9	71	5	26	8	185	22	10·6
5	8	0	22	2	29	0	12	5	71	7	8·9
6	10	1	31	0	32	1	9	3	82	5	5·7
7	4	0	37	1	11	0	2	1	54	2	3·6
8	7	0	19	1	9	0	1	0	36	1	2·7
9	31	0	32	1	15	0	0	0	78	1	1·2
10 or more	133	1	88	4	57	1	3	1	281	7	2·4
Total	751	7	488	33	412	17	210	45	1861	102	5·2

Duration of the Attack (*Table B*).—This table emphasizes the accepted fact that operations from the third to the fifth day carry a high mortality. The mortality of operation on the first day is almost negligible (1·1 per cent); on the second day it is appreciable (2·8 per cent); from the third to the fifth day it is lamentable, being 10·2 per cent for this period. After the fifth day we find the mortality dwindles as the duration of history lengthens.

The most important factor which determines this high mortality of third to fifth day operations is the resistance of the patient, which at this period is at its lowest ebb. Natural immunity to the infection has been exhausted, and acquired immunity has not yet been established, i.e., the patient is in the 'negative phase'. Unnecessary operative interference at this period is obviously dangerous. Operative manipulations and the exposure of fresh surfaces and planes to infection accelerate the absorption of toxins at the period when the patient is unprotected and least able to deal with them.

Thyroid surgery furnishes an analogous condition; operative manipulation causes temporary hyperthyroidism, and hence a quiescent period is chosen for surgical interference. Again, during the war it was common experience that operations which had to be performed on the necessarily badly infected wounds soon after infliction caused exacerbation of toxæmia.

Delayed treatment allows the resistance of the patient to be re-established, and, even if an abscess forms which can only be opened without removal of the appendix, the mortality of the two-stage operation, i.e., opening the abscess and the subsequent clean appendicectomy, is substantially lower than operation during the dangerous period. Also, if localization is occurring at this period, however gentle operative interference may be, or however carefully packing is inserted, the early protective adhesions are easily separated and general peritonitis may result where only a local infection was originally present.

It is perhaps particularly in cases of general peritonitis that delay is valuable. However little manipulation is attempted in operation during the dangerous period, such manipulation accelerates lymphatic and venous absorption, so that toxins are suddenly absorbed when resistance is at its weakest. The rightly-condemned procedure of evisceration and extensive cleansing of the general peritoneal cavity produced acute toxæmia which was euphemized by the term 'shock', and operation in cases of general peritonitis causes toxic absorption in proportion to the amount of interference.

It is well known that cases of ascitic tuberculous peritonitis readily respond to laparotomy, as in these cases intra-abdominal tension is thereby diminished and the lymphatic and vascular channels are encouraged to dilate; hence antibodies flood the affected area. This argument is quite fallacious when applied to cases of acute peritonitis; operation promotes hyperæmia, but there are no antibodies in the blood; the actual result is that toxins are swept away before preparation has been made for their reception.

Cases of acute general peritonitis should be treated on similar lines to an acute cellulitis. In this condition it was formerly the custom to make free incisions into the brawny area, a line of treatment now superseded by conservative measures which allow infection to localize, and if abscesses occur these are subsequently opened. Similarly, general peritonitis should be given the opportunity to subside, and any local collection of pus—e.g., in the pelvis—is drained if toxæmia ensues.

If temporary measures can be successfully employed, the patient's resistance slowly increases; this is reflected in *Table B*, in which it is seen that the mortality decreases as the history lengthens.

Age of Patient (*Table C*).—It will be seen from *Table C* that the majority of cases of acute appendicitis occur between the ages of 10 and 30, the number in this series being 1290, or 67·5 per cent, occurring during these two decades. Suermondt,[3] in a series of 513 cases, found that 41·3 per cent occurred between the ages of 16 and 25. Flint[4] surmises that in young girls the onset of menstruation may predispose to inflammation of the appendix, and that this is particularly liable to occur at the onset of a period.

Table C.—Comparison of Mortality and Age.

Age	Delayed Cases		Inflammation limited to Appendix		Local Peritonitis		Localized Abscess		General Peritonitis		Total		Mortality
	Recov'd	Died	Recov'd	Died	Recov'd	Died	Recov'd	Died	Recov'd	Died	Recov'd	Died	
													Per cent
0–10	27	2	51	1	41	7	49	5	31	15	199	30	13·1
11–20	132	3	281	2	172	10	107	5	67	22	759	42	5·2
21–30	93	2	189	1	131	6	79	2	39	4	531	15	2·8
31–40	41	3	69	1	57	1	38	1	28	1	233	8	3·3
41–50	32	2	28	0	21	2	41	2	9	3	131	8	5·7
Over 50	4	0	9	1	16	2	17	2	9	2	55	7	11·3
Total	329	12	627	6	438	29	331	16	183	47	1908	110	5·4

With regard to prognosis, the mortality is highest during the first decade. Several factors combine to this end. Minor gastro-intestinal disturbances are common during the early years, being chiefly due to injudicious or illicit diet, and hence an acute appendicitis presenting similar initial symptoms is treated as the minor ailment. Thus skilled advice is only sought after the failure of household remedies, which usually consist of laxatives or purgatives. These drugs merely cause intra-abdominal turmoil, which may effectively prevent the infection from localizing or subsiding, especially when administered after perforation or gangrene of the appendix.

Injudicious treatment by diet and drugs during the early stages of acute appendicitis probably explains the failure to subside in many cases in which delayed treatment is unsuccessful, and frequently the history of such cases supports this view. Children are commonly the unwilling recipients of this energetic treatment, the deleterious effect of which is reflected in the mortality list.

Again, the age and intelligence of young children naturally handicaps them in expressing their symptoms, and this may lead to symptoms being missed in the early stages, and the inadequate history may cause errors in diagnosis, so that inappropriate incisions may be made by the surgeon.

Finally, the resistance to infection is less pronounced at the two extremes of life, which is suggested by the fact that delayed treatment, though valuable, is not as uniformly successful in young children as in those of maturer years.

The second decade carries a higher mortality than the third or fourth, which is again probably due to the fact that erroneous diagnosis and treatment are common during the early stages of acute appendicitis in childhood.

The fifth decade shows a slight rise, and the mortality rapidly increases after 50, due to the lowering of resistance associated with the declining years.

Table D.—Complications During Attacks (1803 Cases).

Secondary abscess	52	Pulmonary complications—	
Subdiaphragmatic abscess ..	9	Empyema ..	2
Fæcal fistula	74	Pleural effusion ..	1
Phlebitis	7	Pleurisy	3
Intestinal obstruction	19	Pulmonary embolism	1
Parotitis	1	—	7

(Secondary abscesses were associated on one occasion with a fæcal fistula, and on two occasions with intestinal obstruction.)

Total: 169 in 166 patients; i.e., 9·4 per cent of cases presented one or more complications.

Complications (*Table D*).—I have previously analysed the complications occurring in acute appendicitis, and the addition of the cases for 1923 support the conclusion already drawn. Two points may be briefly mentioned:—

1. The incidental complications occurring in all the cases treated on delayed lines amounted to 6·7 per cent, compared with 11·9 per cent in cases subjected to immediate operation. One also would imagine that sequelæ—e.g., ventral hernia, adhesions, etc.—would show an even greater disproportion in these two groups of cases.

2. Complications following drainage through a gridiron incision still show a marked increase over complications following stab drainage. This drainage may be either suprapubic, or in the loin, or a combination of these two routes.

SUMMARY.

1. When cutaneous hyperæsthesia has disappeared in a case of acute appendicitis, delayed treatment will usually allow the infection to subside.

2. A tentative period of delay does not adversely influence the prognosis, and, combining all cases treated on delayed lines, the mortality, as compared with cases operated on immediately, is nearly halved.

3. Delayed treatment is less uniformly successful at the two extremes of life: in children partly because purgatives are freely administered, and in both cases because resistance to infection is low.

4. The mortality of cases subjected to operation is notoriously high from the third to the fifth days, and especially at this period should delayed treatment be given a trial, so that the patient's resistance may be re-established.

5. Incidental complications in cases operated on immediately are approximately three times as common as in delayed cases.

6. The delayed treatment can only be applied satisfactorily under hospital conditions, when a rigid routine can be strictly enforced. Constant observations must be made regarding alteration of local signs and changes in the general condition of the patient.

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[3] Suermondt, *Deut. Zeits. f. Chir.*, 1922.
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ASEPTIC RESECTION OF THE INTESTINE.

By SETON PRINGLE, Dublin.

The perfect method of performing intestinal anastomosis has yet to be evolved. There are still considerable differences in the details of the technique employed by different surgeons. Indeed, there is divergence of opinion even yet on such an essential matter as the relative advantages of end-to-end, lateral, and end-to-side anastomosis. We are all agreed, however, that the chief danger of the operation lies in the risk of infection, and in the endeavour to overcome this primary risk many efforts have been made to perfect an aseptic technique, and accounts of some of these have appeared in the medical journals from time to time.

Halsted[1] described a method of colectomy which he employed on dogs in forty-seven consecutive experiments without a single failure. He closed the ends of the colon which were to be united by a purse-string suture of silk, and approximated the closed ends by a single row of mattress sutures, completing the operation by puncturing the complete diaphragm thus formed by means of a special guarded knife which he introduced per rectum and which, by means of a long flexible metal handle, he was able to pass up the large intestine to the ileocæcal valve if necessary. He has shown that the internal shelf or partial diaphragm which was left by his procedure rapidly unfolded, and that, if unfolding was not complete, at any rate no serious obstruction occurred.

In another paper Highsmith[2] described a somewhat similar procedure; but he closed the ends of the bowel which he was about to unite by a strand of silkworm gut thrown round the intestine in the groove left by the application of a narrow crushing forceps. The strand of silkworm gut was held in a special 'loop clamp' which is very similar to a nasal polypus snare, the bowel being controlled by the loop of silkworm gut just as the base of a polypus is held by the wire loop of the snare. He then approximated the closed ends, and united them by a row of mattress sutures until only a small gap remained through which the shanks of the loop clamps passed. The loops of silkworm gut in the clamps were then cut and the clamps withdrawn, the lumen of the intestine being thus re-established. The operation was completed by a stitch or two closing the small aperture left by the withdrawal of the clamps.

The work of these two men was experimental, and there is no report of either method having been tried on the human subject; but, in a recent number of the British Journal of Surgery, Fraser and Dott[3] reported a method almost identical with that of Highsmith. They carried out a number of experiments on dogs, and, satisfied with the results, successfully adopted the method in two cases of colectomy for cancer of the colon. In their experiments they confirmed Halsted's finding that the internal shelf left

by the operation rapidly unfolded, but in one patient they had subsequent trouble from persistence of this shelf—trouble which they ascribed to excessive infolding of the bowel.

I have recently employed a method similar, but with several differences in detail—differences which I consider important and tending to perfect the method.

STEPS OF THE OPERATION.

1. The bowel is mobilized, the extent to be resected determined, and the main vessel at the apex of the V-shaped piece of mesentery to be excised is ligatured; any other vessels along the lines of the V running up to the points of section of the intestine are secured, and the mesentery is then divided.

2. A large crushing clamp with blades 1 in. wide is applied to the

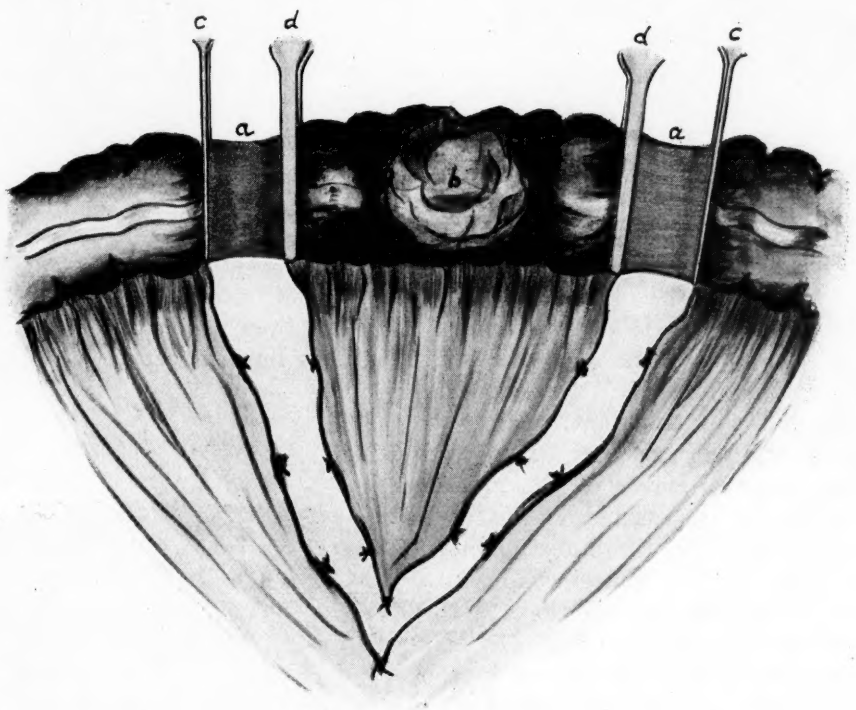

FIG. 172.—*a a*, Crushed segments of intestine above and below the growth *b*. *c c*, Light forceps grasping crushed tissue and controlling the two ends of bowel to be united. *d d*, Heavy clamps controlling the ends of the segment to be removed.

intestine at the point above the growth selected for division (*Fig.* 172). The crushed portion close up to the proximal end of the intestine is caught with fine but strong forceps (*Fig.* 172, *c*). The blades of this forceps are $2\frac{1}{2}$ in. long by $\frac{3}{32}$ in. wide, with longitudinal serrations. The forceps is applied across the intestine so that the tip rests *just short* of the mesenteric attachment—it is important that the tip should not project beyond the margin of the

crushed intestine. When this forceps has been placed, the crushed segment of the bowel close up to the edge of the portion to be removed is grasped in an ordinary heavy straight clamp (*Fig.* 172, *d*). The intestine is then divided through the crushed portion, the knife, as it were, shaving along the lighter forceps, and liquid carbolic acid is applied to the cut edge. The intestine at the site for division distal to the growth is similarly treated, the light forceps being applied to the distal edge of the crushed portion.

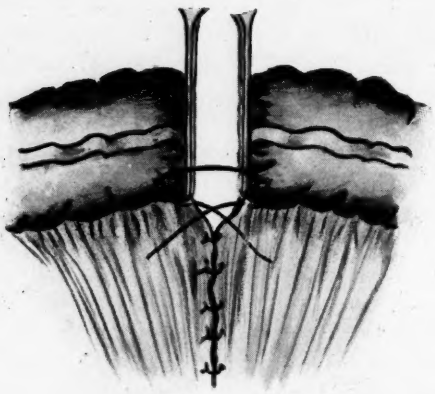

FIG. 173.—The placing of the first mattress suture closing the V gap in mesentery.

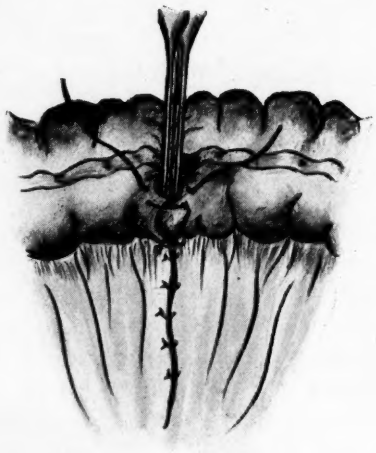

FIG. 174.—Forceps approximated, first mattress suture tightened, second suture in place.

3. The edges of the divided mesentery are then united up to within an inch of the attachment to the bowel. The two light forceps controlling the ends of the intestine are held in apposition by an assistant. A needle carrying 00 chromic gut is passed through the two leaves of the mesentery bounding the triangular space at the attachment to the intestine, and then picks up the bowel wall $\frac{1}{4}$ in. lateral to the forceps and close to the mesenteric attachment. The needle is carried across, and the bowel in the other forceps is similarly picked up; the needle then emerges through the two leaves of the mesentery on the side opposite its original insertion (*Fig.* 173). This stitch when tightened closes the mesenteric gap, and buries the tip of the forceps in a gutter of infolded intestine (*Fig.* 174). A series of mattress sutures, each penetrating to the submucosa, are then passed, burying the forceps from either side, so that when completed the only place where

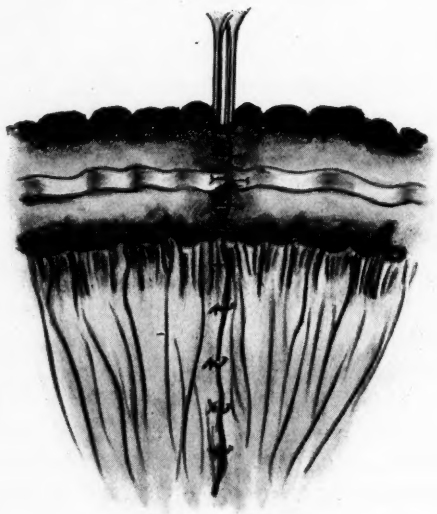

FIG. 175.—Row of mattress sutures completed.

the serous coats of the intestine are not in contact is at the point of emergence of the forceps (*Fig.* 175). Another layer of continuous or interrupted sutures is applied to approximate the intestine further, and, finally, the clamps are loosened and withdrawn and the small gap thus left sutured. When the suture line is completed, if the intestine is picked up between finger and thumb so that one lies above and the other below the line of anastomosis, a free opening will be found to exist between the two segments (*Fig.* 176).

The similarity between the above method and those already reported is obvious. In some details—such as the method of suture—they are practically identical; but there are two points of difference. First, the bowel is divided through a previously crushed portion, so that the mucous membrane is never exposed and the risk of infection is thus reduced to a minimum. Halsted and Highsmith cut through the mucous membrane so that a cuff of it is exposed distal to the encircling ligature, while Fraser and Dott divide the bowel outside the grasp of the crushing clamp. Halsted has shown conclusively that infection of the peritoneal coat round the anastomosis delays, or may even prevent, the unfolding of the internal shelf formed in this method of anastomosis; and so, apart from any risk of gross infection, it is essential that every possible care should be taken to avoid even the slightest chance of contamination. In the second place, I think the use of the clamp as opposed to the use of encircling ligatures lessens the possibility of permanent internal shelf-formation, as the infolding mattress sutures can be placed much closer up to the clamp than to the encircling ligature. Another advantage of my method is that no special instrument such as Halsted's knife, Highsmith's 'loop clamp', or Fraser's 'ligature guillotine' is needed.

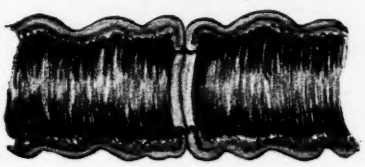

FIG. 176.—Diagrammatic representation of longitudinal section of anastomosis.

The chief criticism that is likely to be directed against this method is the fact that mucous membrane is not sutured to mucous membrane. The experimental work carried out by those workers already referred to showed conclusively, I think, that suture of the mucous membrane was not necessary either for immediate union or final repair. Schoemaker,[4] however, employs a technique in which he makes a circular incision round the intestine through the serous and muscular coats and turns back a cuff of these layers, thus leaving a tube of intact mucosa on which he places two small clamps close together, and divides the intestine between them. Having removed the desired segment of the intestine, the two ends still closed by the clamps are approximated, and end-to-end union is made with an inner sero-musculo-mucous and an outer sero-muscular layer of stitches. The controlling clamp is removed as the last stitch of the inner layer is tied, and thus the anastomosis is completed without the lumen of the bowel having been opened during the operation. There seems to me a distinct possibility of infection from very slight errors in his technique. First, in making the circular incision and in turning back the sero-muscular cuff the mucous membrane might

conceivably be opened; and, secondly, in cases where the bowel above the obstruction is dilated and thin, it must be extremely difficult to take up the mucous membrane with the deeper stitch without penetrating the lumen, or even producing small tears. It would appear therefore that Schoemaker's method introduces certain complications and risks to gain an object which experimental and clinical work has shown to be unnecessary.

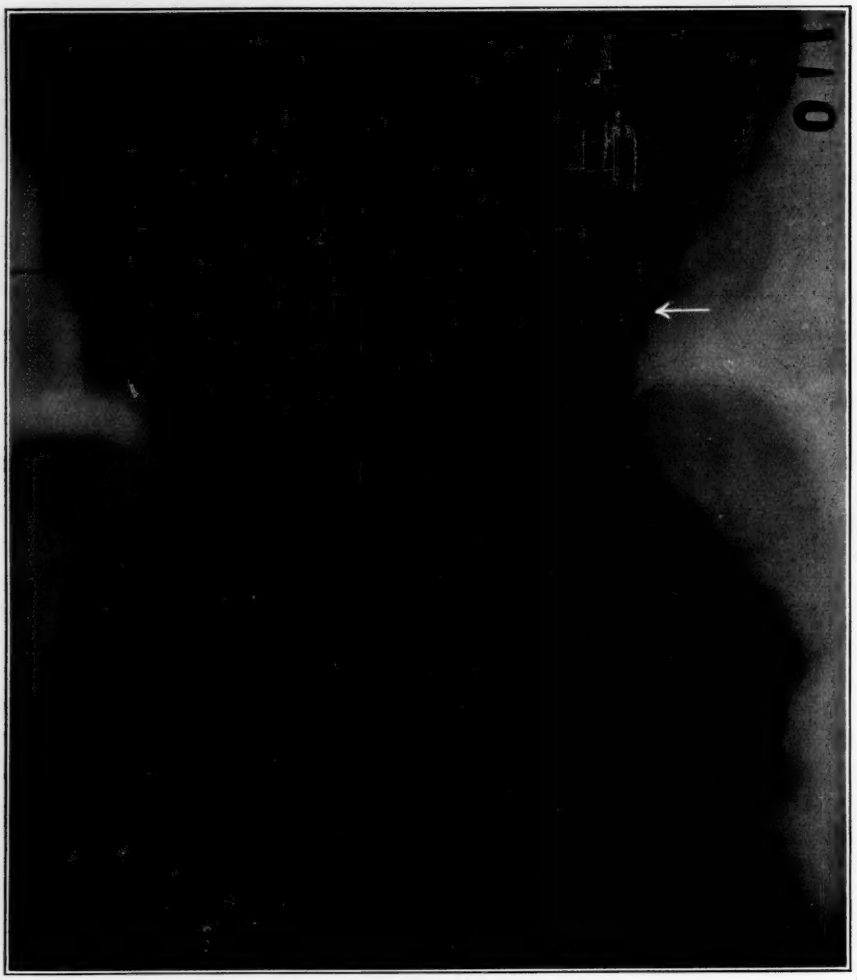

FIG. 177.—Result of barium enema four weeks after resection, demonstrating absence of obstruction. The site of anastomosis is indicated by the arrow.

I have carried out my methed in three cases, of which short notes are appended. In each the time of operation was shorter, the hæmorrhage less, and the risk of infection enormously diminished, as compared with other methods. In each the immediate recovery was excellent; none of the patients had the slightest sign of local or general infection, and convalescence in all three was remarkably smooth.

CASES.

Case 1.—A. W., male, age 62. Admitted with subacute intestinal obstruction. After five days' preliminary treatment with purgatives and enemata, the abdomen was opened and a cancer of the iliac colon resected, end-to-end anastomosis by the method above described being carried out. The operation was completed by performing a cæcostomy. Convalescence was quite uneventful, the cæcostomy gradually contracting, and the bowels moving per rectum three weeks after the operation. The X-ray (*Fig.* 177) demonstrates the absence of any obstruction, though the site of anastomosis is indicated.

Case 2.—M. L., male, age 52. Admitted complaining of diarrhœa for past year. The middle two-thirds of the transverse colon were obviously filled with a fæcal mass; there was also a hard, nodular tumour to be felt in the right iliac fossa. With purgatives and enemata the colon was emptied, and five days after admission the abdomen was opened. It was then found that there was a cancer of the cæcum, with a second pedunculated tumour of the transverse colon. The small intestine was divided 6 in. above the ileocæcal valve, the colon was resected to within a few inches of the splenic flexure, and end-to-end anastomosis of the small intestine to the colon carried out. The bowels moved per rectum on the fourth day, and convalescence was quite uneventful. Microscopical examination showed that both tumours were carcinomatous.

Case 3.—J. J., female, age 52. Admitted with subacute intestinal obstruction. As enemata failed to relieve, cæcostomy was carried out. Twelve days later the abdomen was reopened and a cancer of the splenic flexure resected, end-to-end anastomosis being performed. In this case also convalescence was uninterrupted, apart from the fact that some pouting of the mucous membrane took place through the cæcal opening, and a plastic operation was required for its closure. Following the latter operation the action of the bowels was normal, liquid paraffin being the only aperient needed.

Note.—A fourth successful resection of the colon, with end-to-end anastomosis of the ileum to the transverse colon by this method, has since been performed.

I wish to express my indebtedness to Dr. E. C. Smith for the drawings which illustrate this paper.

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POLYCYSTIC DISEASE OF THE KIDNEYS.

(*Congenital Cystic Kidney.*)

By ROY F. YOUNG, Glasgow.

This disease is characterized by the presence of multiple cysts in the kidney substance. In the great majority of cases both kidneys are affected. That this condition can no longer be regarded as a pathological curiosity is proved by the numerous illustrative contributions on the subject in the medical press within the last fifteen years. The following five cases, seen within the last five years, provide additional evidence.

Case 1.—J. N., male, age 52. Admitted to hospital in May, 1919, complaining of pain in the right flank. For two years he had suffered from a dull, gnawing pain in the right lumbar region, and increasing unfitness for work, but no noticeable loss of weight. After admission a tumour of the right kidney was discovered, and the kidney was removed. This proved to be a cystic kidney. I did not see this patient till five days after operation, by which time uræmic symptoms had developed, with hiccup, drowsiness, and scanty output of urine. The left kidney was enlarged, elastic, and movable. The patient died thirteen days after operation.

A post-mortem examination showed the left kidney to be enlarged and cystic, with little normal tissue between the cysts. There were no changes in the liver, nor any other evidences of developmental defects. Nor was there any history of similar disease in the family.

Case 2.—F. W., male, age 36. Admitted to the Western Infirmary, Glasgow, in January, 1922. Seven years previously, he states, he received a blow on the left flank, which was followed by hæmaturia of six days' duration. Two years later he had another attack of hæmaturia. On neither occasion was there any pain. His next attack was four weeks before admission, when the amount of blood passed was large, and was accompanied by a sharp, stabbing pain in the left side. His previous health was good ; the family history negative. A large elastic tumour could be felt in the left lumbar region, but the right kidney could not be palpated. The liver was not enlarged, but the superficial venules over the lower hepatic area were dilated. Urine : 1020, acid, large amount of blood ; the microscopic deposit showed red blood-cells only. Blood urea : 41·4 mgrm. On cystoscopic examination the bladder was found to be healthy, the right ureter normal, but blood was coming from the left ureter. Two days later, as the hæmorrhage was increasing, the kidney was exposed from the lumbar route, and a large polycystic kidney, free from adhesions, was found. On account of the hæmorrhage the kidney was removed. The kidney measured 6½ by 3½ in. To the naked eye the normal kidney tissue was replaced entirely by cysts ; the pelvis was distended with blood.

After operation the amount of urine passed in twenty-four hours, which had been within normal limits, fell, varying from 10 to 30 oz. He also developed a persistent hiccup which lasted for sixteen days. By the eighteenth day the urine reached normal limits, and when he left hospital, five weeks after operation, it averaged between 50 and 60 oz. Two days prior to leaving hospital the urine was acid, 1018 ; no albumin or blood ; a few hyaline casts were seen by microscope. The blood urea was 54·9 mgrm.

He reported in March, 1922, about ten weeks after operation. He had put on

one stone in weight. At the end of April he was feeling well, but felt an occasional dull aching in the right loin. The lower pole of the right kidney could now be palpated, but was not tender. Urine: 1025, acid, no blood or albumin; passing about 40 oz. in the twenty-four hours. Blood urea: 46·3 mgrm. Reported in March, 1923. Had kept well, was well nourished and was not losing weight. Had been at work for ten months. Lower pole of right kidney palpable, but felt firm, and of normal contour. Blood urea, 38·7 mgrm.; urea concentration, 2·3 per cent; urea concentration factor, 45.

In February, 1924—two years after operation—his health remains good, he is able for full work, is not losing weight, and does not suffer from pain or discomfort. The kidney has not increased in size, and the urine is healthy, about 50 oz. being passed in the twenty-four hours.

In this case it appears reasonable to suppose that the cystic disease was unilateral.

Case 3.—G. E., male, age 36. Admitted to the Western Infirmary, Glasgow, in November, 1922, with a history of occasional attacks of hæmaturia of five years' duration. In June, 1917, while on active service in France, he had his first attack of hæmaturia, for which he was treated in hospital as a case of nephritis. The next attack was in 1919. There were subsequent occasional attacks of hæmaturia, the bleeding lasting for two or three days. In September, 1922, during another attack, the left kidney was found to be enlarged. He has never suffered pain on any occasion. Family history is negative.

On admission, a firm, elastic tumour was present in the left side, occupying the left lumbar and hypochondrial regions, and extending forward into the umbilical region. The tumour moved with respiration, and could be pushed forward from the back, but was not tender. The right kidney was also enlarged, but to a much less degree. Urine: 1016, neutral, small amount of albumin; on microscopic examination of the deposit a few pus-cells were found, but no red blood-cells nor organisms. The amount of urine varied from 60 to 95 oz. in the twenty-four hours. Blood urea, 63 mgrm.; urea concentration test, 1·2 per cent; urea concentration factor, 16. On cystoscope examination the bladder and ureter openings appeared quite healthy. A diagnosis of bilateral polycystic disease of the kidneys was made.

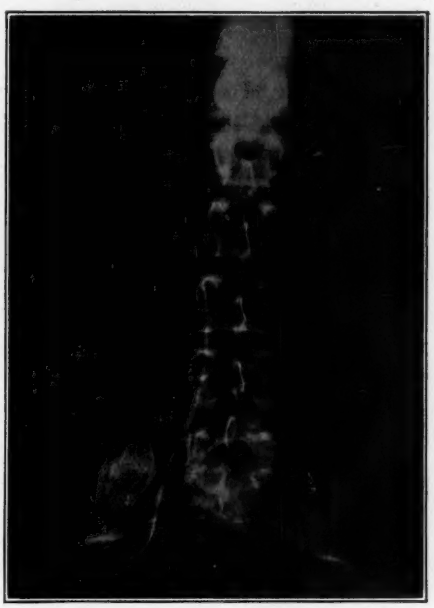

Fig. 178.—*Case* 3. Pyelogram of left pelvis.

He was readmitted in September, 1923, for examination. In the interval he had been at full work as a platelayer, and had kept well. Both kidneys had increased in size. The blood-pressure was 170, but the heart was not increased in size. Urine: 1010, acid, with a trace of albumin; the deposit showed some pus-cells and triple phosphate crystals, but no blood. The amount of urine in twenty-four hours was low for two days, but this was succeeded by a polyuria of from 80 to 90 oz. Blood urea, 72 mgrm.; urea concentration test, 1·0 per cent; urea concentration factor, 12·5. An X-ray examination showed the diaphragm on the left side to be at its normal level. With a barium enema the descending colon was seen to be pushed well over to the middle line, while the ascending colon occupied its usual position.

Readmitted in January, 1924. He had been at his work until a fortnight

previously, when he had to discontinue owing to a gnawing, jagging pain in the left side, which lasted two days but was not accompanied by hæmaturia. A week later he suffered from a complete obstruction of the colon for three days. He has been losing weight. There was an obvious further enlargement of the left kidney, which now reached almost to the umbilicus, and was visible on inspection. The right had remained much as before. Blood-pressure, 160. Urine: 1007, acid; no albumin; triple phosphates, only, found in the deposit. Blood urea, 95·6 mgrm.; urea concentration test, 0·9 per cent; urea concentration factor, 8·4.

Mr. Walter Galbraith kindly undertook the pyelography of the kidneys. That of the left kidney, which is here reproduced (*Fig.* 178), does not show any definite characteristic, while it was found impossible to get any clear shadow on the right side, possibly on account of pressure on the pelvis.

As the left kidney, on account of its bulk, had threatened on occasions to cause intestinal obstruction by pressure on the descending colon, it was decided to attempt to lessen the bulk of the kidney by operative means. Under local anæsthesia the organ was exposed through the abdominal wall where the tumour was most prominent. This portion of the kidney, at its lower pole, was incised, and about 5 oz. of fluid were evacuated. This fluid had all the appearances of altered blood, and did not contain urine. The edges of the incision in the kidney were sutured to peritoneum, and the cavity packed through this. He made an uninterrupted recovery, but the cavity still requires packing. His general health is good.

Fig. 179.—Photograph of kidney removed in *Case* 4. Each square of the background measures one inch.

On examination of the specific gravity of the separated urines, that from the left—and more extensively affected—kidney was between 1000 and 1005, while that from the right was between 1005 and 1010.

Case 4.—Mrs. B., age 52. Admitted to the Royal Alexandra Infirmary, Paisley, in March, 1923, with a swelling in the left side of the abdomen, which had first been observed two years previously, but had caused neither pain nor discomfort. It had gradually increased in size, and on admission she complained of an aching, dragging pain in the side, which was worse when she was up. There was some frequency of micturition, small quantities of urine being passed at a time. There was some discomfort after food, with occasional vomiting, increasing anorexia, and loss of weight. The left kidney was enlarged, elastic, and movable, but the right kidney was not enlarged, nor was there any enlargement of the liver. Urine: 1010, acid, with a trace of albumin. In the deposit were present pus-cells, a few red blood-cells, and scanty hyaline and granular casts. Urea concentration test, 2 per cent. X-ray examination was negative, but with a barium enema the descending colon was seen to be pushed inwards towards the middle line. On cystoscopic examination the bladder and ureter openings were seen to be healthy.

At operation the kidney was exposed through the abdominal route, and was found to be cystic. The right kidney was examined by palpation, and appeared to be normal in size, shape, and consistency. The left kidney was removed.

Report on kidney by Dr. Hannay (*Fig.* 179): Weighs 13 oz.; irregular shape, measuring 6½ by 4 in. at upper pole, by 1 in. at lower pole. It is solid in the central part, and cystic at each end. The ureter is not dilated. The renal artery is smaller than normal. On section there is a spherical, encapsuled cyst, 3 in. in diameter, at the upper end, and a sausage-shaped cyst, 2½ by 1 in. at the lower pole, with a small amount of kidney substance in front of each, and a larger quantity between them. There is no dilatation of the pelvis. There are about a dozen smaller cysts in the remaining kidney tissue. There is recent extravasation of blood in the adipose tissue surrounding the pelvis. The fluid in the two large cysts measures 6 oz., and resembles urine.

Report on microscopical appearances (*Fig.* 180): There are a number of small cysts in the cortex and medulla, some of them giving rise to a certain amount of compression of the adjacent renal tissue; these cysts are lined by a single layer of flattened cells. The cortical epithelium shows some degenerative change, chiefly fatty. In places there is a slight increase of interstitial tissue. The blood-vessels are not abnormal.

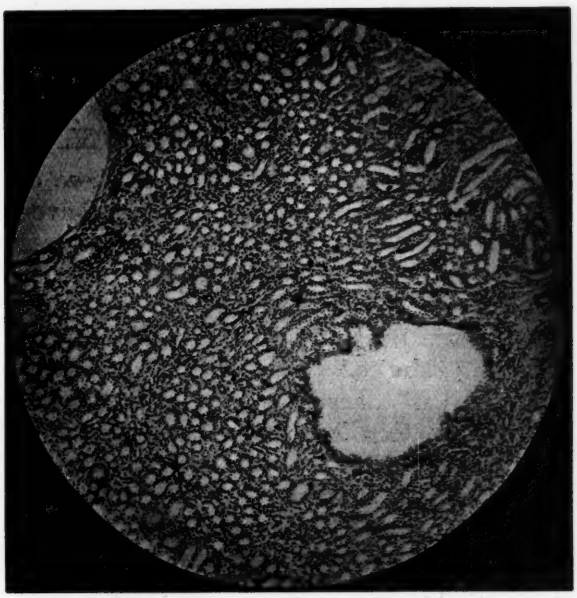

FIG. 180.—Section (×40) through pyramidal portion of kidney in *Case* 4, showing one small cyst and portion of another.

This patient made an uninterrupted recovery, and left the hospital a month after operation. The urinary output, which had been low, remained so after operation, averaging 20 oz. in the twenty-four hours.

In November, 1923, she was readmitted, complaining of pain in the right side of an aching character, also of frequency of micturition, and a scalding pain during the act. For the past three months she had suffered from headache and defective eyesight, and had noticed a puffiness under the eyes in the morning, and some swelling of the legs at night. The right kidney was enlarged, movable, but not tender. Urine: 1014, acid, with distinct albumin; deposit showed pus-cells and organisms which, on culture, proved to be *B. coli*. She left hospital much improved under treatment with bicarbonate of soda.

In February, 1924, her condition was satisfactory. She was fit to carry on her work, and did not suffer from any pain. Her weight was the same as on previous admission. The kidney apparently had not increased in size, but felt somewhat irregular. Urine: 1004, acid, with a trace of albumin; no pus, casts, or organisms were found. Œdema of the eyes was still present in the morning.

In this case it is impossible to say if the right kidney has undergone cystic changes. The enlargement may be due to hypertrophy, but the irregularity is suspicious.

Case 5.—F. M., male, age 42. Admitted to the Western Infirmary, Glasgow, in September, 1923, complaining of attacks of hæmaturia of five months' duration.

In 1917, while in the army, he was treated for nephritis. Apart from this his previous health had been good. The family history was negative. During the last two years he has gradually been losing weight. Five months ago he had an attack of hæmaturia, and since then he has had occasional similar attacks. At no time was there any pain.

Both kidneys were found to be distinctly enlarged, elastic to the touch, and movable, the right kidney being larger than the left. The liver was not enlarged, and other developmental defects were not present. The heart was not enlarged; blood-pressure, 160. Urine: 1016, acid, with trace of albumin; the deposit contained a few pus-cells. The output of urine in the twenty-four hours varied between 40 and 70 oz. Blood urea, 26·4 mgrm.; urea concentration test, 1·7 per cent; urea concentration factor, 49. On cystoscopic examination the bladder was seen to be healthy, and urine was coming from both kidneys.

The diagnosis was made of bilateral polycystic disease. I have not been able to get in touch with this patient since.

PATHOGENESIS.

The cause of the formation of these cysts has not yet been established, but several explanatory hypotheses have been advanced. The earliest is that of Virchow, who believed that the condition was due to an intra-uterine obstruction of the kidney tubules by uric acid and lime infarcts. Subsequently he considered that it was due to an intra-uterine papillitis, produced by the uric acid and lime infarcts causing atresia and obliteration of the collecting tubules.[1] His opinion was based on the presence of a round-celled infiltration with accompanying interstitial nephritis and atresia of the papillæ. This explanation is no longer accepted. It has been pointed out that these inflammatory changes are a result, not the cause, of the cyst formation, "a view which is supported by the greater density of the sclerosis round the larger than round the smaller cysts"[2]; also, as Tow points out,[1] many cases of cystic kidney have been reported in which papillitis could not be demonstrated. Virchow's explanation also fails to explain the developmental defects which are met with, apart from the kidneys, in many of these cases.

The most attractive hypothesis, and the one which receives most support, is that of Kuster, who attributed the cyst formation to an irregular congenital development of the kidneys. The ureter arises as a tubular diverticulum from the Wolffian duct, and from the ureter are developed the pelvis and collecting tubules of the kidney. The uriniferous secretory tubules, on the other hand, are formed in mesoderm, known as the metanephric cell mass. As the collecting tubules grow out into the developing kidney, they acquire connections with the uriniferous tubules.[3] Failure to establish a junction between these tubules would result in the formation of cysts within the uriniferous tubules. In the records of the post-mortem examinations of the Royal Hospital for Sick Children, Glasgow, there is an interesting case of congenital absence of one kidney, which would appear to corroborate this view of these cysts:—

No. 387. Male infant. Imperforate anus and hypospadias. On the left side the kidney is in its normal position, but larger than normal. On the right side the kidney is absent, also the ureter and renal vessels. In place of the kidney there is a small cystic mass.

A possible explanation of this may be that the metanephric cell mass was formed, but, owing to the failure of the Wolffian duct process to develop, cystic dilatation occurred in the embryonal structure.

The presence of liver cysts and other congenital maldevelopments associated with many of these cases serves to strengthen this view; also the history of hereditary polycystic disease in some families. If this view of congenital development be correct, it is difficult to understand why the disease should be commoner in the middle-aged than in the young, unless one concludes that the cysts remain latent in youth, and, with the advent of age, commence a gradual increase in size, at a time when more stress is thrown on the kidneys, whose power to respond is diminishing. McKinlay, agreeing with their congenital origin, believes that such cysts may remain quiescent, but that, when present in sufficient quantity to stimulate hyperplastic compensatory change in the renal parenchyma, the lesion will be a progressive one.[4]

A third hypothesis, which has received considerable support, suggests a neoplastic origin of the cysts, of the nature of a multilocular cystadenoma. Brigidi and Severi, in 1870, formed this opinion because of an increase in the number of layers of epithelium lining many of the cysts, the presence of epithelial sprouts with surrounding connective tissue from the walls of the tubules, and a pseudo-papilliferous formation on the inner walls of many of the cysts.[1] Against this it has been pointed out that similar epithelial changes were found by Busse to be present in all embryonal kidneys. Also, the changes such as described above are not constant, the epithelial elements frequently being diminished and replaced by connective tissue. McKinlay considers that proliferation of the epithelial lining of the tubules, even attempts to form new, possibly atypical, tubules, may be evidence of compensatory effort by the healthy parenchyma of an organ whose efficiency has been handicapped by malformation.[4]

POSSIBLE ETIOLOGICAL FACTORS.

Certain factors, common to a number of cases cited in the literature, help to throw some light on this condition.

Heredity.—It would appear to be unusual to find a family history of polycystic disease, but there are undoubted authentic cases on record. Eisendrath[5] found one family in which five members had this disease. Tow cites Dungar for several examples: Virchow's case of four children of the same mother in all of whom polycystic kidneys were found; five children of another mother; a father, son, and nephew; and a father, son, and sister, with symptoms in other children of the same family.[1]

Age.—Clinically the disease is met with at two periods of life—in infancy and middle life. The occurrence in infancy is rare, and it is seldom found between infancy and twenty-one years of age. In the post-mortem records of the Royal Hospital for Sick Children, Glasgow, since 1915, out of a total of 1411 cases, there is only one case of polycystic disease of the kidneys, unless the one mentioned above is included (No. 387).

No. 748. Male, age 41 weeks. The left kidney shows congenital cystic malformation. It is increased in size to that of an adult kidney, and is converted into a mass of thin-walled cysts with clear or dark-coloured contents, and no trace of intact kidney substance is found. The right kidney, liver, and spleen are healthy.

Ballantyne mentions a case in which delivery of the child at birth was obstructed by a renal tumour of this nature.[6]

Sex.—It is generally agreed that this disease is commoner in females than males. In the cases reported here, four were males and one a female.

Other Congenital Deformities.—There are numerous examples where polycystic disease of kidneys is associated with other congenital deformities. Cysts in the liver are not uncommon; Moschowitz[7] estimates their association as 19 per cent, and Eisendrath[5] as 18 per cent of cases. Other deformities which have been noticed are hare-lip, cleft palate, spina bifida, meningocele, hypospadias, and cardiac defects. Ballantyne quotes a case of associated hydrocephalus,[6] and Thomson-Walker one of horseshoe kidney. In my cases no associated deformities were discovered. In the post-mortem reports of the Hospital for Sick Children, mentioned above, though there are several cases of horseshoe kidney, in none of them was there cystic disease.

Bilateral Disease.—It is the exception to find the disease confined to one kidney. Kidd,[8] in collecting 149 cases from the literature, found that 9 were unilateral—6 on the left side and 3 on the right.

PATHOLOGY.

The general naked-eye appearance of the kidney, in the majority of cases, is now well recognized. The kidney retains more or less its normal shape, but is enlarged, in some cases enormously so. The normal kidney tissue appears to be replaced entirely by numerous cysts of variable size, giving an appearance of what has been described as 'a bunch of grapes'. In other cases, such as *Case* 4, a considerable area of normal tissue is retained, which, however, shows numerous cysts under the microscope. To the naked eye this specimen (*Fig.* 179) approaches more closely the condition described as 'large, solitary cyst' of the kidney. It is very doubtful, however, whether the solitary cyst of the kidney should be differentiated from the polycystic kidney; in the majority of cases the presence of other cysts in the kidney will be found, and the origin of the cysts is probably the same in both conditions.

The fluid contents of the cysts are not distinctive. The fluid is a clear straw colour, unless there has been hæmorrhage into the cyst, when it becomes blood-stained or dark brown. Albumin, urea, and various salts are present.

The walls of the cysts are lined either by columnar or flat epithelium. In some cases this epithelium shows proliferation, at times having the appearance of intracystic papillary growths; in other cases, such as shown in *Fig.* 180, this proliferation of epithelium is absent. In the early stages, as seen in this same section, the neighbouring renal tubules are healthy, and there is little increase of interstitial tissue. With the increase of the cysts there is corresponding increase in the interstitial fibrous tissue, with pressure on, and gradual disappearance of, the renal tubules.

SIGNS AND SYMPTOMS.

By some authors three stages of the disease are distinguished: the latent; the second stage, when the tumour is present; and the uræmic. The latent period is variously given as from three to ten years. If the congenital

theory of the causation be accepted, the length of the latent period must necessarily be that of the age of the patient at which the first sign of disease was established. The first sign by which disease is detected is said to be the presence of a tumour. Of the five cases here reported, however, in three the first evidence of disease was hæmaturia, all three of whom were males. In the detailed reports of cases which I have come across, this fact seems to be borne out, that in men the first sign is hæmaturia, in women tumour. The possible explanation may be that, in women, a transient hæmaturia may be more readily missed, or may be attributed to other causes.

Premonitory Symptoms.—A careful investigation into the history of each case will generally furnish some evidence of renal insufficiency prior to the onset of hæmaturia or the discovery of a tumour, such as headache, nausea and loss of appetite, with increasing unfitness for work. Some patients have recognized a progressive loss of weight.

Tumour.—Only by the discovery of a renal tumour is there any likelihood of a diagnosis being established. A bilateral enlargement of the kidneys makes the diagnosis practically certain. In the vast majority of cases the disease is bilateral, but one kidney is always in a more advanced stage than the other, in which it may not be easy to detect enlargement. In a few cases the disease is unilateral. The tumour feels elastic, but not fluctuant, and in some cases the irregular cystic protrusions on the surface may be detected. The kidney is not fixed.

Pain.—This is not a constant feature, only about one-half of the cases complaining of pain. It is felt in the lumbar region, and is commonly of a dull, aching character, seldom sharp or stabbing.

Hæmaturia.—According to some writers, hæmaturia is comparatively infrequent. Thomson-Walker, quoting Luzzato, puts it at 16 per cent, while Pousson found it in one-third of the cases.[9] It is probably much more frequent than this. In four of my five cases it was present. The hæmaturia is intermittent, painless, and not severe. There may be long intervals between attacks—as long as two years elapsing in one of my cases. Renal colic, due to clots, is conspicuously absent. In a few cases the hæmorrhage may be very severe, as in *Case* 2 reported here. In one case, reported by Rolando,[9] the hæmorrhage, which lasted two weeks, was so severe that the bladder was distended with clot; and Eisendrath[5] states that the hæmaturia may be so severe as to cause death.

Other Urinary Changes.—The character of the urine is that of chronic interstitial nephritis, with a low specific gravity and an acid reaction. Microscopic examination of the sediment may show a few hyaline or granular casts; red blood-corpuscles and pus-cells are not infrequently present. In the majority of cases, polyuria is present until the late stages of the disease, but this is not always so. There is little difference in the urine from the two kidneys, but Fullerton[10] has recently drawn attention to an increased diuresis with lower specific gravity in certain cases of renal disease; in two cases of bilateral cystic disease he found that in one the disease was more advanced on one side, and that the specific gravity of the urine from that side was lower. This is also true of *Case* 3.

Renal Efficiency Tests.—There is not sufficient evidence as yet upon

which to form a definite opinion on this much-debated question. Of my cases, only one, *Case* 3, has had the blood urea, the urea concentration test, and the urea concentration factor adequately worked out. Other renal efficiency tests have been discarded as unreliable. In this case the failing renal efficiency is corroborated by the tests. *Case* 2, according to the tests, developed an improved renal efficiency after nephrectomy.

X-ray Signs.—The ordinary X-ray plates of the renal regions have not, in my experience, proved of any assistance in the diagnosis of this condition. The method of showing up the kidney by the introduction of oxygen into the surrounding tissues would doubtless be of assistance, but it is a method one would hesitate to employ in this condition. A barium enema will show if the colon is displaced towards the middle line, but where this is present the kidney can be palpated readily.

Rolando[9] claims that, in cases where the right kidney is enlarged but it is difficult to define the condition of the left kidney, X rays will show the presence of an increase in size, " The left kidney, when increasing in size, in place of growing downwards towards the iliac region, as occurs with the right kidney owing to the resistance of the liver, enlarges upwards and displaces the diaphragm upwards, so that the lowest border of the left lung, instead of corresponding with the level of the tenth rib, may lie at the level of the ninth, eighth, or even seventh rib ". This was a well-marked sign in two of his cases, in one of which it was corroborated at the post-mortem examination. Since reading his article I have investigated this in two cases, but in neither was the level of the diaphragm raised, though in *Case* 3 the left kidney was greatly enlarged.

Pyelography.—Braasch[11] states that the pyelograph will identify the cystic nature of the tumour in over half the cases, " The pelvic outline of bilateral cystic kidney is characterized by flattening of the calices, giving a general oval contour to the pelvis, in contradistinction to the retracted calices of the malignant tumour. Occasionally, however, a retraction of the calices may also be found with the bilateral cystic kidney, but it is then broad and open and not slit-like or narrow ". Eisendrath has not found pyelography of much assistance. In the only case of those reported here in which pyelography was undertaken, nothing distinctive was found.

Cystoscopic Examination.—This is only of value by reason of negative findings. The bladder and orifices of the ureters are healthy in appearance. In the event of hæmorrhage, of course, the affected side will be discovered.

Compression by Tumour on Surrounding Structures.—This has only been noticed in one case here (*Case* 3), where pressure caused obstruction of the descending colon. Rolando[9] quotes several authors who cite cases where the renal tumour caused obstruction of the ascending or descending colon; also a case of Glaser's where pressure on the common bile-duct resulted in death from suppurative cholangitis.

Cardiovascular Changes.—These are dependent on the associated chronic interstitial nephritis, but may be present in infancy, as in Tow's case[1] of a boy six weeks of age with great hypertrophy of the left ventricle. In Rolando's six cases a transient hemiplegia occurred in three; and in McKinlay's case[4] the patient, age 30, was admitted with a hemiplegia,

advanced arteriosclerosis of the aorta and vessels being found post mortem. It is common to find the blood-pressure higher than normal.

Presence of Other Congenital Defects.—These were not present in any of my cases, but they have been observed by many writers and may help in arriving at a diagnosis.

Uræmic Symptoms.—These occur in the terminal stage of the disease, and are common to all advanced renal diseases.

TREATMENT.

It is now universally agreed that operative interference, nephrectomy in particular, should be avoided in this condition. *Case* 1 offers sufficient proof. In the few cases where the disease is unilateral, nephrectomy would be the correct treatment, but absence of enlargement of the other kidney—even when examined by intra-abdominal palpation, as in *Case* 4—is no proof that a latent cystic condition is not present. In *Case* 2 I had to resort to nephrectomy because the patient's life was endangered by hæmorrhage. From the subsequent history of this case it would appear that the disease, very fortunately, was unilateral.

Apart from nephrectomy, less radical operative proceedings have been carried out. Fixation requires but passing mention. Rovsing has found puncture of the cysts to be of value in relieving pain. Thomson-Walker writes that nephrotomy with evacuation of the large cysts has been performed for pain, and may be tried in anuria. Marion[12] has found a modified form of decapsulation successful for the relief of pain in three of his cases. The capsule is adherent to the walls of the cysts, but decapsulation may be carried out by snipping off the capsule with scissors, thus opening up the superficial cysts, any outgrowths from the walls of which are also removed. Balfour[13] carried out similar treatment in two cases with the idea of reducing the bulk of the kidney. In both cases drainage was provided for but proved unnecessary. While such treatment cannot be regarded as curative, it suggests a reasonable procedure for the relief of renal tension, as evidenced by constant aching in the lumbar region, and anuria ; also in cases where the actual bulk of the kidney may be causing obstructive pressure on neighbouring organs. As a general rule, however, operative treatment should be avoided, and the patient should be treated on the same lines as in chronic interstitial nephritis.

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WHITE MYELOMA OF THE RADIUS.

By T. H. BURLEND and D. J. HARRIES, Cardiff.

This case is interesting clinically as it shows that in children a graft of dead beef-bone gives much the same result as a living autogenous graft.

The patient, a girl, age 9, fell on her right arm in November, 1921, and was treated for a Colles's fracture; but as the swelling above the wrist did not subside, she was sent in January, 1922, to the out-patient department of the Royal Infirmary. Radiographs (*Fig.* 181) taken on Jan. 25 show the myeloma involving the lower third of the radius. The growth extends downwards almost as far as the epiphysial line, and has actually penetrated its bony shell and invaded the periosteum in two places.

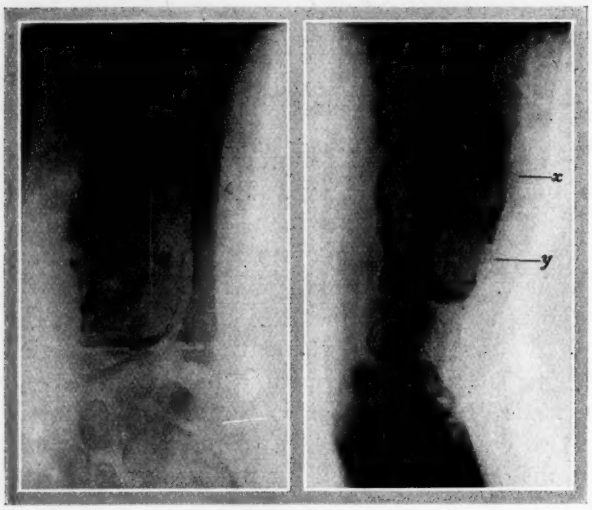

Fig. 181.—Radiographs of the right lower forearm, anteroposterior and lateral views. At *x* and *y* the myeloma has perforated the thin bony shell.

OPERATION.

On Feb. 3, 1922, the lower portion of the radius was removed, leaving the epiphysis intact. The periosteum was left *in situ*, except at the two points where it had been invaded by the growth. A bone-graft of the size and shape shown in *Fig.* 182 was cut from an ox tibia the day before the operation, and boiled for half an hour before insertion. The upper end was pushed into the medullary cavity of the radius, as shown in the illustration, and the periosteum was sutured round the graft. The arm was bandaged on a splint until the skin sutures were removed. It was then put up in plaster. *Fig.* 182 shows the graft *in situ* on the second day after the operation. Radiographs taken respectively two, four, and fifteen months after the operation are shown in *Figs.* 183, 184, and 185. *Fig.* 185 shows the graft completely absorbed and the radius restored. The radius is not growing at the same rate as the ulna, and this accounts for the radial deviation of the hand.

The patient was encouraged to use the fingers and thumb from the start, and the plaster splint was discarded three months after the operation.

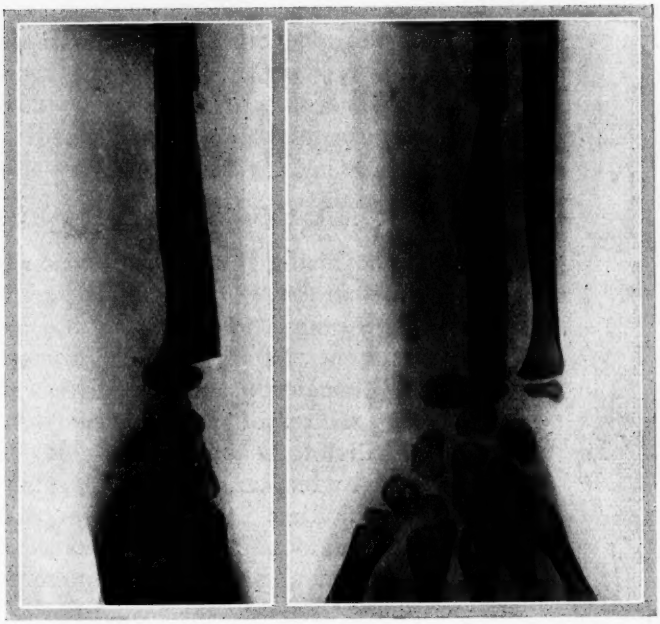

FIG. 182.—Radiographs taken two days after the operation. The somewhat pointed upper end of the bone-graft is visible in the medullary cavity of the radius.

FIG. 183.—Radiographs showing the condition two months after operation. A marked formation of callus has occurred, and the graft is undergoing absorption.

Movements were very little affected at any time, and now, in spite of the radial deviation of the hand, are practically normal. It may be found necessary to remove a part of the ulna to compensate for the slow growth of the radius; but at present it is doubtful if the functional value of the arm could be improved by any operative treatment.

FIG. 184.—Radiograph of the lower forearm four months after operation. Note the extensive callus. The remains of the bone-graft are darker in appearance than is the newly-formed bone.

MICROSCOPIC APPEARANCE.

Our histological examination deals with: (1) *The structure of the tumour itself;* (2) *The boundary zone between tumour and bone or tumour and marrow;* and (3) *The marrow beyond the myeloid expansion.* We shall describe the histological features of these regions separately.

1. **Histology of the Tumour.**—The growth appears to replace the normal marrow; it consists of spindle cells each with an oval or elongated nucleus, and exhibits here and there throughout the myeloma, particularly numerous near the periphery, large giant cells. In the ordinary red myeloma the colour is explained by the presence of hæmorrhagic extravasations of large size and regions highly vascularized. In the white variety, extravasated blood and vascularized areas are of less frequent occurrence. The concentration of the spindle cells is not uniform, a fasciculated

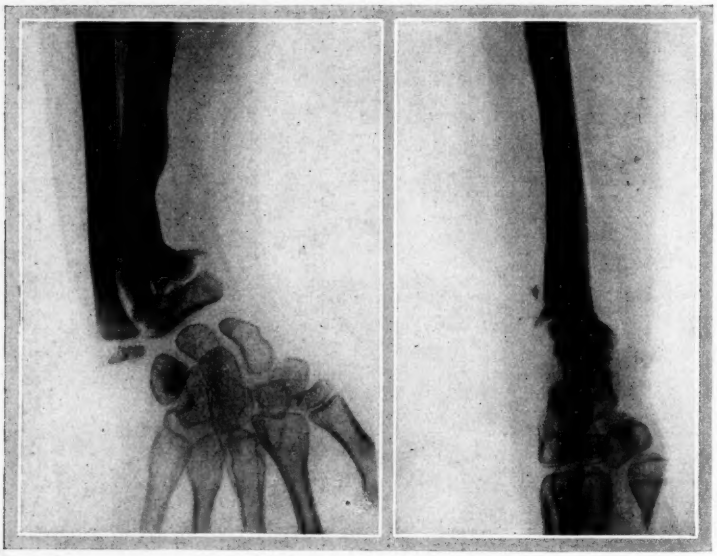

FIG. 185.—Radiographs taken fifteen months after operation. The regenerated lower third of the radius exhibits radial deviation. The bone-graft has disappeared entirely.

appearance being observable ; in a groundwork of loosely scattered cells there appear to be areas of closely-packed spindle cells usually surrounding giant cells : the probable explanation being that spindle cells arise in the dense areas and invade those where there are few cells or none. No signs of mucoid degeneration are observable. Megakaryocytes having a typical annular nucleus, and myelocytes normally present in marrow, are absent. Although the marrow is entirely replaced, there are still some bone trabeculæ to be seen. Many of these show necrotic changes. The trabeculæ are the remains not only of the spongy bone at the end of the radius but also of the perimedullary bone, the absorption of which keeps pace with the growth of the tumour. There is still a shell of bone, perforated in places, around the myeloid growth beneath the periosteum. A description of a white myeloma has been given by Stewart.[1] The tumour which he describes is also at the lower end of the radius. With most of the histological details given by him we are in agreement, although we consider that the tumour is not a mixed-(mainly spindle-) cell sarcoma as stated by him, but is composed entirely of giant cells and spindle cells, ' small or round cells' being absent. It is probable that what we conclude are spindle cells cut transversely were described as 'mixed' cells by Stewart. This conclusion is supported by the observation that where bundles of spindle cells are cut longitudinally no cells resembling 'small cells' are visible. Hence the accounts of a myeloid sarcoma (or giant-cell sarcoma)—not necessarily of the white variety—given by Macallum[2] and Ewing[3] more closely coincide with our interpretation of the structure of the tumour.

Cytology of the Spindle Cells.—The cells which form the bulk of the tumour vary in size and shape. In some regions they are elongated and arranged in bundles, and in these the nucleus is also elongated and often stains deeply ; in other regions the cells are shorter and the nuclei oval. In all cases the nuclear membrane is well defined, and within the nucleus are two prominent karyosomes as well as scattered granules of basichromatin. The nuclei vary in length from 11 to 16 μ and in width from 3 to 6·5 μ. We observed a great similarity in the nuclei of the spindle cells, osteoblasts, osteoclasts, and giant cells ; in some cases the spindle-cell nuclei are more elongated, and in other cases they appear swollen ; but with respect to nuclear membrane, karyosomes, and chromatin particles there is little or no difference. It has already been mentioned that blood extravasations and vascular areas are present in both grey and red varieties of myeloma, but especially in the latter. Some extravasations and blood-vessels contain blood only, others are being invaded by spindle cells. That a migration of spindle cells occurs from the tumour into the vessels and extravasations, and not in the reverse direction, is clearly indicated in our sections. Of these invading spindle cells, those nearest the margin of the blood-spaces closely resemble the ordinary cells of the myeloma ; those which have penetrated into the spaces have more elongated, thinner, deeper-staining nuclei and fusiform outline. Some others are rounded or angular.

Giant Cells.—Unquestionably the most interesting elements in the myeloma are the giant cells. These are found throughout the tumour, but are very numerous near the periphery. Where the spindle cells are most plentiful and

concentrated, viz., in the deeper parts of the myeloma, the giant cells are rare. As we have already stated, those giant cells present within the myeloma are usually surrounded by fasciculi of densely-packed spindle cells. Typically the cytoplasm of the giant cell is markedly eosinophil and counterstains readily with eosin; thus the giant cells contrast with spindle cells, the cytoplasm of which is not eosinophil in reaction. This property is not constant, however, and the cytoplasm of some giant cells shows gradations in colour from intense

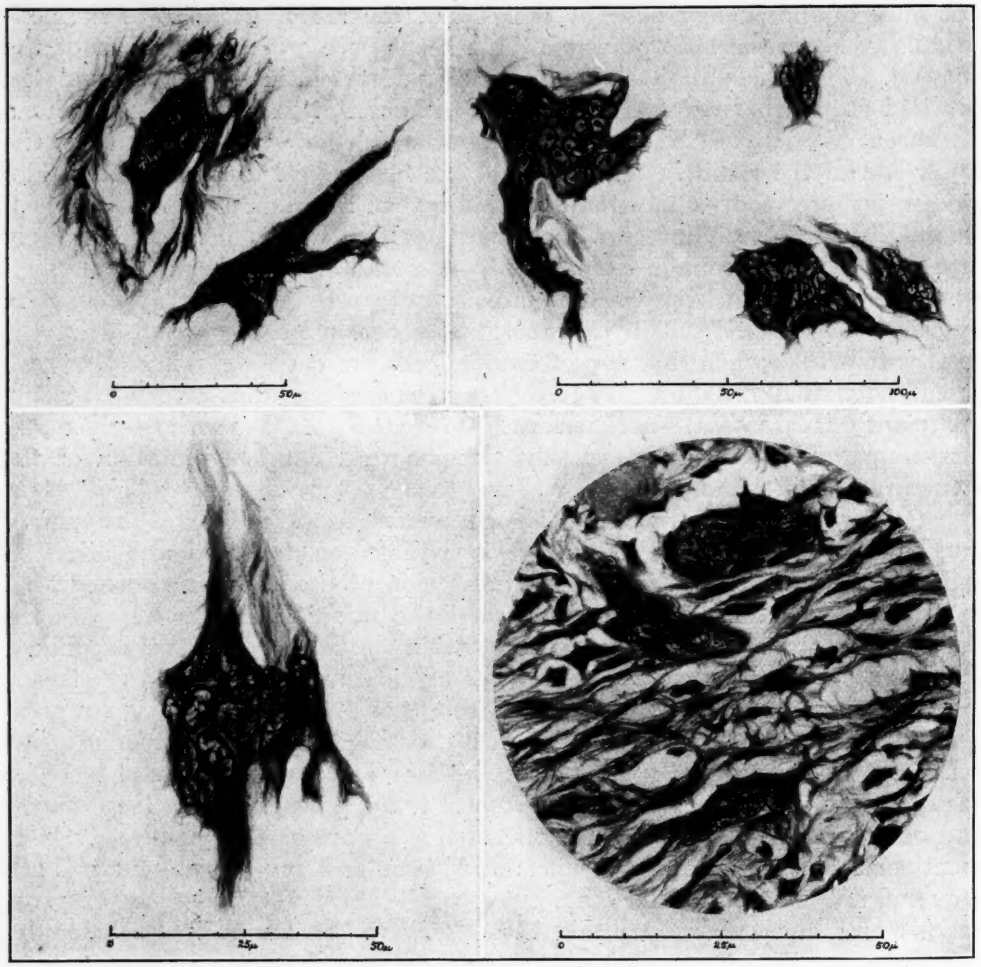

FIG. 186.—Giant cells of the myeloma drawn under high power. There is great variation in size, shape, and number of nuclei. The nuclei of some spindle cells shown in the lower right-hand figure resemble the giant-cell nuclei.

pink to that assumed by the cytoplasm of the spindle cells. The number of nuclei present in the giant cells varies considerably (see *Fig.* 186), from two or three up to twenty-four and more. As we have counted at least twenty-four in some cells it is safe to conclude that this number is greatly exceeded in many cases, when it is remembered that we are examining thin sections and that some giant cells attain dimensions greater than the thickness of a section.

The nuclei of the giant cells so clearly resemble those of the spindle cells, both in the possession of well-defined nuclear membrane and two karyosomes, and also in size, that we have measured a great many for comparison. They average about 13 μ in length and 5 μ in diameter, though some few very elongated nuclei attain a length of 18 μ. As stated above, the spindle-cell nuclei vary in length from 11 to 16 μ, and in width from 3·5 to 6·5 μ. There is the same variation in the outline of the giant-cell nuclei (from oval to spindle form) as occurs in the spindle-cell nuclei.

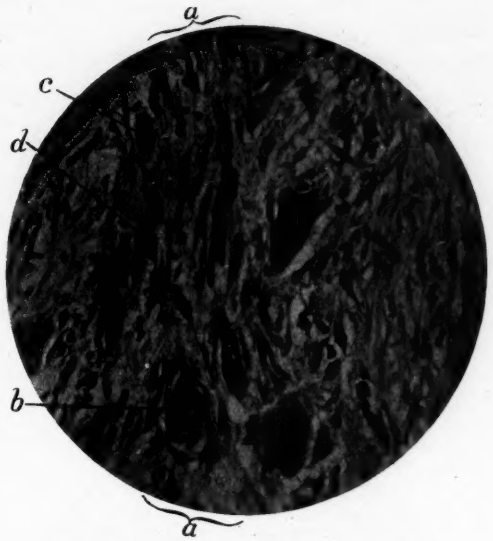

FIG. 187.—A portion of the myeloma containing giant cells. *aa*, Fasciculus of spindle cells produced from the giant cells shown. The one *b* presents a stage of fragmentation; another (*c*) is still smaller; while that at *d* is difficult to distinguish from a group of spindle cells.

The size and shape of the giant cells vary as much as does the number of their nuclei. The giant cells with two or three nuclei are only distinguishable from spindle cells by the multinucleate condition, their nuclei being similar and their cytoplasm not eosinophil (*Fig.* 187). In very many cases the giant cells have long processes in which nuclei (one or more) are present (*Fig.* 186); often these processes, or a considerable portion of the margin of a giant cell, merge imperceptibly into the surrounding spindle cells, so that it is difficult or almost impossible to define the margin of the giant cell. Some giant cells occur in groups, the cells in some cases being so closely contiguous that we have reached the conclusion that the appearance indicates a fragmentation of a giant cell into smaller cells (*Figs.* 186 and 187). Vacuoles (one or more), some containing leucocytes, are visible in many of the giant cells. Sections stained with Leishman or Giemsa clearly demonstrated the phagocytic character of these giant cells, red as well as white corpuscles having been ingested.

FIG. 188.—Two giant cells highly magnified. Note the curious arrangement of the nuclear chromatin in the cell on the left.

In addition to the giant cells with resting nuclei, there are a few—presumably giant cells—with nuclei

exhibiting karyokinetic changes such as are usually associated with protozoa (*Fig.* 188). The nuclei of the cell to the left side of *Fig.* 188 appear to have a nuclear membrane with chromatin attached to it. To the right side of *Fig.* 188 the resting nuclei of a giant cell are shown for comparison. Howard[4] has described giant cells with nuclei which show protozoan characters. We do not propose to deal with the significance of these nuclear appearances until we have further investigated them.

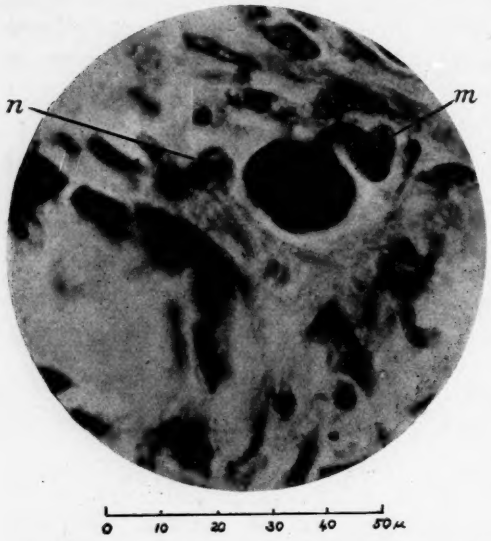

FIG. 189.—A multinucleate cell in the myeloma with small deeply-staining nuclei and eosinophil cytoplasm. A portion of the latter (*m*) containing two nuclei is becoming detached from the main mass. Another uninucleate cell probably derived from the large cell is seen out of focus at *n*.

Another interesting variety of multinucleated cell is depicted in *Fig.* 189. The cytoplasm is strongly eosinophil, and the nuclei (eleven of which can be seen in the figure) are much smaller than are those of the ordinary giant cell (3 to 4 μ), and moreover stain intensely and uniformly. The microphotograph is of a cell magnified to the same extent as the giant cells seen in *Fig.* 188. We are disinclined to believe that a cell such as the one shown in *Fig.* 189 is a giant cell in the pyknotic condition.

Beyond a brief reference to these cells, which may have an important rôle in the etiology of the tumour, we defer consideration of their significance until we have examined additional material.

Giant cells are numerous in the neighbourhood of blood-spaces; but not frequently, in fact rarely, do they appear in the vessels or extravasations. Where spindle cells are invading blood-spaces the giant cells are usually small, and most probably fragmenting to give rise to spindle cells. We have seen nothing to indicate that the giant cells have an angioblastic origin, and no evidence that the giant cells are brought to the tumour in the blood-stream.

FIG. 190.—Longitudinal section of radius including the lower end of the myeloma (*p*), the intermediate zone (*q*), and the normal marrow (*x*).

2. Histology of the Region between the Myeloma and Subperiosteal Bone or Bone-marrow.—In this region, marked *q* in *Fig.* 190,

there are for the most part numerous blood extravasations in which are seen, in addition to the formed elements of the blood, a great many giant cells or osteoclasts. We use the terms synonymously, because there is no structural character which can be applied whereby the giant cells of this tumour may be distinguished from the numerous osteoclasts also present. With regard to variability in dimensions, contour, and staining reaction, and the number, size, shape, and structure of the nuclei, we find no marked difference between giant cells and osteoclasts; only in cases where a multinucleated cell was in close relation to the bone, e.g., in a Howship's foveola, could we with certainty consider the cell as an osteoclast and not a giant cell. It follows therefore from this last statement that the giant cells in the myeloma may be osteoclasts which have ceased to function as bone-destroyers. Our observations on this point have led us to conclude that the giant cells in a myeloma of the epulis type are, or are derived from, osteoclasts.

In the zone between bone and tumour there are in places bone trabeculæ surrounded by numerous, apparently normal, active osteoblasts; in other places osteoclasts are engaged in destroying the bone which the osteoblasts are producing (*Fig.* 191). There is no doubt that the bone trabeculæ and the subperiosteal bone are removed by osteoclasts which are not only abnormally large but also abnormally numerous, the subperiosteal bone becoming first cancellous and later reduced to trabeculæ ever diminishing in size. Owing to the progress of the myeloma, these trabeculæ become incorporated within it, and later undergo necrosis. Since the osteoclasts are not numerous in the normal marrow adjoining the tumour, and are in our opinion not carried to the tumour by the blood, the most reasonable assumption is that they are formed in great numbers at the boundary between bone and tumour. The nuclei of the osteoclasts vary between 11 μ and 8 μ; those of the osteoblasts also range from 8 to 11 μ in length. Erythrocytes in these sections are about 6 μ in diameter, so the measurements quoted above are probably somewhat lower than those for the fresh unfixed cells. The close similarity in size and structure which exists between the nuclei of osteoblasts and osteoclasts favours the view that the latter are produced by a fusion of the former. The possibility of osteoclasts being derived from marrow is more than doubtful, since there are no tissue-cells in marrow with nuclei at all comparable with those of the osteoclasts. Some trabeculæ in this region are covered with osteoblasts,

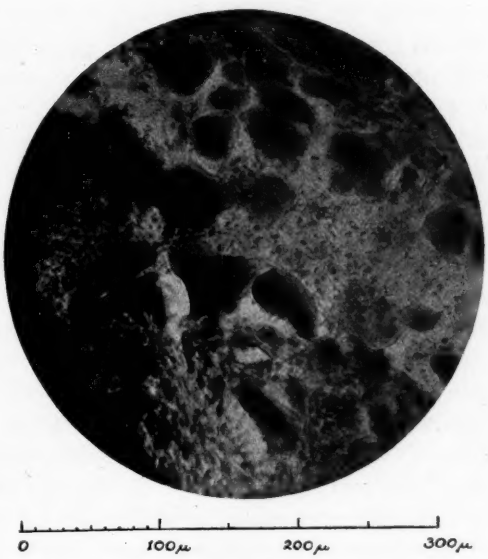

FIG. 191.—A portion of the intermediate zone between myeloma and bone showing the numerous osteoclasts or giant cells. On the extreme left is the bone (black).

which in places appear to be undergoing fusion. The change which is occurring at the boundary of the tumour is not apparently due to a deficiency of osteoblasts, but to a disproportionately large number of osteoclasts. Furthermore, many of the osteoclasts in this region are surrounded by spindle cells, and in some cases the former appear to be fragmenting to give rise to the latter.

In the region marked q' in *Fig.* 190, where growth is proceeding towards the epiphysial line, an invasion of the marrow by giant cells and spindle cells is observable, so that beyond the myeloma towards the marrow there is an intermediate or boundary zone consisting of giant cells, spindle cells, marrow elements, and blood. Beyond this again normal marrow is found.

3. **Histology of the Marrow beyond the Boundary Zone.**—There is nothing noteworthy about the marrow beyond the intermediate zone.

DISCUSSION.

It is probable that a myeloid sarcoma is produced by the formation in abnormal numbers, by the fragmentation later, of osteoclasts which remove the bone very quickly; in consequence the bone becomes thinner and thinner until it (and the periosteum overlying it) is pierced, and the tumour-cells invade neighbouring tissues. Radiographs of the lower third of the affected radius demonstrate the thin shell of bone surrounding the growth: the diameter of the diaphysis in this region is distinctly greater than that in the normal diaphysis (*Fig.* 181). This increase can only be accounted for by supposing (1) that subperiosteal bone is deposited abnormally quickly beneath the periosteum, and (2) that the bone nearest the marrow cavity is absorbed or destroyed even more quickly by irregular osteoclastic activity.

The transitional zone affords most evidence of the probable origin of the tumour, since histologically it differs less from the normal than does the myeloma; in this zone the abnormal features are the excessive number of osteoclasts, the presence of spindle cells (not as concentrated as in the myeloma, but anticipating the condition of the latter), and the reduction in the number of fat-cells and other constituents of marrow. Perhaps the condition which is primarily responsible for the excessive formation of osteoclasts is the chief, if not the only, etiological factor in the origin and growth of the myeloma. These cells are produced normally at first to remove calcified cartilage, and at a later stage in bone-development to remove bone (both trabecular and periosteal), whereby the marrow-cavity is increased in size; the ratio between thickness of diaphysis and diameter of marrow cavity is maintained within certain limits, which are an expression of greatest efficiency and strength of the bone, having regard also to economy of material. On functional grounds, therefore, it is legitimate to compare osteoclasts with 'foreign'-body giant cells: both are employed in removing material which is useless, or a hindrance to optimum development, and thus 'foreign' in the metabolism of the body. The conditions normally determining the formation and activity of the osteoclasts are not known. It may be that physical stresses in the bone are responsible, in the same way as they are responsible for the arrangement of the trabeculæ at the end of a long bone, as well as for the protuberances of bones.

With regard to the cause of origin of a myeloma, the following are possible explanations: (1) A local injury to the periosteum (e.g., trauma caused by a blow) may result in hypertrophy of periosteal bone, and to preserve the ratio of thickness of bone shaft to diameter of marrow cavity an abnormal number of osteoclasts are produced. (2) There may be some change of metabolic origin resulting in the existing bone becoming altered in chemical composition and thereby calling into existence osteoclasts to remove it. (3) Some agency may cause a local change whereby the osteoclasts are abnormally increased in number; stimulation of osteoclasts to form, or, if formed, to multiply to excess, may result from the presence of a foreign body, parasite, or even wandering cells from some other part of the body. The following appear to us to be objections to (1) above. The infrequency of incidence of myeloid sarcoma as compared with the frequency of cases of bone injury seems to imply that some other attendant factor must be assumed if we are to attach much weight to this view; the injury would affect the subperiosteal lamellæ of bone more than the perimedullary; why, therefore, should the latter be removed at all? The chief objection to (2) is that a metabolic change would most likely be attended by a generalized pathological condition, and not one localized as is usually the case in myeloma. The few cases of multiple myeloma which occur can be satisfactorily explained by (3). On the whole, therefore, a local abnormal stimulation of osteoclast formation or of osteoclast division, whether auxetic, kinetic, or katabolic, seems to us the most probable explanation of the presence of large numbers of osteoclasts or giant cells at the periphery of a benign epulis. That it is not the presence of the spindle cells which is responsible for the giant cells is clear when we recall the distribution of the latter: i.e., few in the centre, where the spindle cells are most abundant, and numerous at the edge of the growth, where the spindle cells are comparatively scarce. Clinical evidence appears to favour (3), viz., that owing to some localized condition osteoclasts are formed in great numbers; in other words, a condition is created favouring the formation of osteoclasts.

Origin and Structure of Giant Cells and Osteoclasts.—Two kinds of giant cells in myeloma have been described—the true and the false. According to Poncet,[6] the former are as large as three or four ordinary spindle cells, and contain five or six nuclei; the latter are rather larger and contain twelve to twenty nuclei; the 'false' giant cells are very numerous in the benign epulis. Borst drew a distinction between giant cells of medullary sarcoma and those of periosteal origin; he accepted a multiple origin for giant cells. Mallory[7] distinguished true tumour giant cells (which may multiply by mitosis) from foreign-body giant cells (of bone and other sarcomas) represented in the epulis type of sarcoma; the former differ chiefly in size and number of nuclei from the latter, which are transformed wandering endothelial leucocytes not produced in the tumour. Virchow and Rindfleisch[8] believed that, when bone-matrix is absorbed, the osteoclasts set free produced giant cells of the epulis type: thus they identify giant cells with osteoclasts. Robin[9] and Nélaton[5] took the same view. Wyss,[10] Ziegler,[10] and others trace the origin of giant cells in sarcoma to bone-forming cells; Ziegler suspected that osteoclasts might not all originate in the same way. Wegner,[10] Malassez,[11] Ritter, and later observers have reached the conclusion that giant cells of the epulis type are

derived from modified endothelium and are therefore of angioblastic nature. Ewing[3] considers that it is necessary to recognize in morphology and origin two types of giant cell in bone sarcoma. The type most common in benign epulis is chiefly of endothelial origin, and is a foreign-body giant cell which does not participate in the tumour process; the other type is derived from the tumour-cells, and occurs chiefly in malignant tumours of the periosteum. We consider that divergence of opinion upon the question as to whether there is more than one kind of giant cell in benign epulis is explained by the fragmentation process which these giant cells undergo; the gradations in character of the giant cells are similarly explained. The multinucleated cell shown in *Fig.* 189 does not correspond with either of the types mentioned above.

Various other sources of origin of osteoclasts have been suggested: e.g., marrow mesenchyme, cells of the periosteum, connective-tissue cells carried by the blood to the medullary cavity may be cited to illustrate the uncertainty of our knowledge on this interesting problem.

Since these multinucleated cells are present wherever bone is to be removed, or, as in the case of the milk teeth, where the roots are to be absorbed, it is not unreasonable to postulate that they have an origin *ad hoc*, and that they are formed in a similar way to other foreign-body giant cells. Judging from our sections, we should unhesitatingly conclude with Kölliker and others that the osteoclasts are derived from the osteoblasts, for the following reasons: the great similarity in appearance, size, and staining reaction of osteoblast nuclei and the nuclei of an osteoclast; the fact that the two kinds of cells are always associated; that where an osteoclast is found against a bone, osteoblasts are absent; and the occurrence sometimes observable of osteoblasts apparently fusing together. In the myeloma we have described, the osteoclasts are very numerous at the periphery of the tumour nearest the bone; they are not so numerous where the tumour and marrow are continuous. We therefore favour the views of Kölliker that osteoclasts are derived from osteoblasts and ultimately break up into osteoblasts. Virchow, Rindfleisch, Robin, and Nélaton came to the same conclusion. Lambert's[12] work on the cultivation of the spleen of the chick in plasma indicates that spleen-pulp cells may fuse to give rise to giant cells. Thus this function is not confined to endothelial cells or to lymph-cells.

Formation of Spindle Cells.—The osteoclasts produced in great numbers do not, in our opinion, confine their attention solely to bone removal. The histological evidence appears to indicate that while some destroy the bone, others become phagocytes upon the elements of the marrow, viz., myelocytes, fat-cells, red and white blood-corpuscles, etc., and thus account for the absence of the normal constituents of marrow in the myeloma. We observed many giant cells which contained in their protoplasm other cells. Other giant cells presumably lose their osteoclastic function and undergo a process of dedifferentiation, i.e., they fragment into smaller and smaller cells until the uninucleate spindle-cell condition is arrived at, the original osteoclast nuclei becoming elongated and swollen in the process (*Figs.* 187, 192, 193). Similarly nuclei of cells undergoing dedifferentiation in tissue cultures become slightly swollen. The following is a summary of the evidence in favour of this view: The giant cells or osteoclasts in the myeloma are most numerous at the margin;

they vary in size, shape (many are elongated and have processes—*Fig.* 186), and number of nuclei (from twenty-four and upwards down to two); their cytoplasm exhibits gradation in its affinity for eosin—the giant cells with only a few nuclei have cytoplasm which resembles that of the spindle cells in not staining with eosin; the close resemblance between osteoclast and spindle-cell nuclei; the signs of fragmentation of many giant cells; and the difficulty of determining the boundary of some giant cells. To these we may add, in support of the view that the spindle cells are formed *in situ* and not brought by the blood, the fact that the blood-spaces have in them at first no spindle cells, but become invaded by them later; although some spindle cells are seen to be undergoing mitosis and possibly also direct division, the absence of any marked mitotic or amitotic division of the spindle cells seems to exclude the possibility of any appreciable tumour growth in this way. Finally, the clinical evidence that growth of a myeloma is most rapid laterally, viz., in the neighbourhood of the bone where the osteoclasts are formed, rather than, as one would expect, along the line of least resistance, viz., the marrow cavity. The earliest stage of the disease has been traced by some writers to the walls of small 'cysts' or cavities which form in osteitis fibrosa cystica. Such an origin is not inconsistent with an osteoclastic fragmentation resulting in tumour formation.

FIG. 192.—Giant cells undergoing fragmentation.

FIG. 193.—A group of giant cells arranged in such a way as to suggest that the larger cells divide up into smaller cells with fewer nuclei. At *a* some osteoblasts are visible. Their nuclei closely resemble the nuclei of the giant cells.

Although fragmentation of cells in the manner described above is not known to occur in normal cell-division, yet when we recollect how these giant cells probably arise, viz., by a fusion of uninucleated cells, it is not unreasonable to predict that any dedifferentiation of the cells will begin with a division of the multinucleate cells to produce cells with a single nucleus. Carleton[13] defines

dedifferentiation as "the return of previously specialized elements to a simpler and more embryonic type"; it is the reverse of differentiation—"the process of specialization, functional and structural, of cells and tissues". Champy[14] describes how, in tissue cultures of non-striated muscle-cells of the urinary bladder, the cells become swollen, lose their myofibrils, and cease to show any of the characteristics of the previously highly differentiated muscle-cells. Complete dedifferentiation to an indifferent condition occurs, and the resulting cells approximate in appearance to the undifferentiated cells of the early embryo.

Champy[14] also was the first to notice that in tissue cultures some of the cells ingest phagocytically other elements present. Thus in testis cultures the Sertoli cells first agglutinate and then ingest the spermatocytes. We have mentioned that the giant cells ingest other cells; this may be explained as the normal function of these cells, indeed their *raison d'être*. It is perhaps not without significance that whereas many observers have noted the phagocytic properties of the giant cells in myelomata, histologists are far from unanimous with regard to whether osteoclasts ingest bone or destroy it by producing an enzyme. If this difference in function exists between osteoclasts and giant cells, it may be cited against our view that the osteoclasts are the giant cells in a benign epulis. On the other hand, the phagocytic function assumed by the osteoclasts is characteristic of some dedifferentiating cells.

FIG. 194.—The giant cells referred to in *Fig.* 193 under higher magnification. One smaller cell at *a* is just about to separate from the main mass *b*; the separation is not yet complete.

Yet another question of interest is the influence of environment on tumour-cell outline. It has been mentioned above that, where an invasion of a blood-space occurs in the myeloma, the cells in the blood are usually fusiform with elongated nuclei, though others appear to be small and round. At the periphery of the space the invading cells have more oval nuclei, like the great majority of the tumour-cells. This observation is in accordance with the findings of Uhlenhuth[15] for tissue growth in culture—the growth in a semi-hard medium was effected by fusiform cells migrating individually into the surrounding plasma.

Since these observations were made, we have read Carleton's admirable critical summary of tissue culture,[13] and we cannot refrain from noting the parallelism which in our opinion exists between the behaviour of the cells producing the myeloma, and certain established phenomena in cultures of

tissue, viz., dedifferentiation and phagocytosis. In dealing with the application of tissue culture, Carleton asks this question, " Are the factors which produce dedifferentiation on the part of specialized tissues *in vitro* the same as those which produce the formation of malignant tumours *in vivo*? " The evidence which we have given bearing on the formation of the benign epulis indicates that the factors may be the same. Although we do not contend that the method of formation of a giant-cell myeloma is a prototype whereby the formation of malignant growths may be explained, it is sufficient at this stage to observe that many tumours apparently benign may later become malignant.

SUMMARY AND CONCLUSION.

1. The giant cells in a benign epulis or giant-cell myeloma appear to be derived from osteoclasts.

2. The removal of the marrow by giant-cell phagocytosis and the formation of the tumour cells by fragmentation of giant cells may be likened to the dedifferentiation changes which occur in certain cells in tissue cultures.

3. A few giant cells were seen in the myeloma with nuclei exhibiting an uncommon type of karyokinesis which is associated with some protozoa.

4. Some few other multinucleate cells with small nuclei and strongly eosinophil cytoplasm were seen : observations upon these are being continued.

We are indebted to Professor R. C. McLean for kindly permitting us to use the photomicrographic apparatus in his department ; also to Miss M. White for the drawings in *Fig.* 186.

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[14] *Arch. de Zool. Exp.*, li–lv, lx.
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PLEXIFORM NEUROFIBROMA OF THE SOLAR PLEXUS.

By HERBERT A. BRUCE, Toronto.

One of the most valuable contributions to the subject of tumours of nerves was that made by Mr. Alexis Thomson,[1] Professor of Surgery in the University of Edinburgh, in a monograph on neuroma and neurofibromatosis, published in 1900.

The term 'neuroma' was introduced by Odier, of Geneva, in 1803, to designate "tumours formed by diseased enlargements of the nerves". William Wood,[2] of Edinburgh, discussing the origin of neuromata in a paper in the transactions of the Medico-Chirurgical Society of Edinburgh in 1829, believed them to originate from the connective-tissue sheaths of the nerve, and not from the nerve tissue itself. He remarked upon the inefficacy of medicines, and recommended removal of the tumour by operation. Amongst others he quoted a case from the *Encyclopédie Méthodique de Chirurgie* (Paris, 1792) in which amputation was performed for what was undoubtedly a plexiform neurofibroma of the median nerve of the forearm. Smith, of Dublin, in his classical work on neuromata in 1849, considered that the mere anatomical connection of a tumour with a nerve was sufficient to regard it as a neuroma, whatever its structure might be. However, Virchow, in his lectures published in 1863, placed the pathology of neuromata on a new basis, by classifying them on a structural instead of a clinical basis, and dividing them into the true and the false—the former composed mainly of new nerve tissue, the latter (pseudo-neuroma) of connective tissue derived from the sheaths of the nerve. True neuromata are very rare, but several authentic cases have been recorded.

Attention is called to the present case of plexiform neurofibroma of the solar plexus, not only because of its inherent interest and rarity, but because it has to be taken into consideration in a differential diagnosis of abdominal tumours; however, as I am only able to find one other case of plexiform neurofibroma affecting the solar plexus in the literature, one given by Bruns,[3] it will not be necessary to work out elaborate methods for its detection.

J. K., age 35, referred to me by Dr. R. J. MacMillan, gave a history of having been injured in a fall at the age of 18. He had never had any serious illness until an attack of influenza four years ago which confined him to bed for three months. Since that time he has had constant pain in his back in the right lumbar region, accompanied by tenderness on deep pressure, usually relieved by a belladonna plaster. At irregular intervals, increasing of late, this pain in his back would be so severe as to confine him to bed for several days, and was generally regarded as lumbago. When free from these attacks he had a good appetite, appeared to be in good health, although always very thin, and carried on his usual work. The tumour became palpable about three months before I saw him. Two months ago he suffered from lienteric

diarrhœa, which cleared up on milk diet. For the last few weeks he had not been able to retain any solid food, and had even vomited most of the fluids given. When he entered the hospital his urine was found to contain diastase. Examination of the abdomen disclosed a tumour about the size of a grape-fruit in the mid-epigastric region, only very slightly movable from side to side. It felt solid, and had a tympanitic note over it. The abdomen otherwise was very thin, tense, and emaciated. There was no pigmentation of the skin, and no nodules were seen in any other part of the body.

An X-ray examination was made by Dr. H. M. Tovell, who reported as follows :—

> **There is no definite radiographic evidence of a pathological condition in the stomach or bowel which would indicate ulceration or malignancy. There is evidence that a mass external and posterior to the stomach is pressing upon the lesser curvature and also upon the transverse colon. From the position of the mass one would be suspicious of the pancreas ; yet there is no evidence of displacement of the duodenum, which assumes the usual relation to the stomach, which one would think would not be the case if a pancreatic tumour were present.**

However, a diagnosis of 'tumour of the pancreas' (probably a cyst) was made, and it was thought that the injury referred to above might have been a causative factor. Under anæsthesia the tumour, which was very hard and nodular, could be moved freely from side to side, and to a less extent from above downwards. On making the incision, the transversalis fascia was found tightly stretched over the tumour, and when it and the peritoneum were divided, the tumour popped out as if under great pressure. It was then seen to press forward the gastrohepatic omentum and the stomach, which was tightly stretched over it. The pylorus, which was lying in the middle line, was widely dilated, as were also the first and second portions of the duodenum. The glands along the greater and lesser curvatures were not involved. The tumour mass was about the size of a grape-fruit, distinctly nodular, and appeared to be connected with the pancreas. Thinking it malignant and inoperable, after removing a couple of nodules for microscopical examination, the abdomen was closed, but with considerable difficulty.

We were surprised at receiving a report from the pathologist that the section was a myoma. In view of these findings, and the fact that the patient was unable to retain any nourishment owing to the mechanical effect of the tumour in shutting off the outlet of the stomach making a fatal result inevitable in a very short time, we decided to try to remove the tumour. The former incision was re-opened twelve days later, and a thorough examination of the tumour, both through the gastrohepatic omentum and the transverse mesocolon, revealed it lying behind the pancreas, which was not involved. A good deal of difficulty was met with in dissecting out the growth, as a number of very large blood-vessels coursed through it. The mass looked a little like a thick tapioca pudding, with a fine mesh of fibrous tissue stroma between the little nodules. The patient recovered nicely from the immediate effects of the operation, and the same evening his pulse was good and his condition seemed satisfactory. However, he died suddenly the next morning, probably from pulmonary embolism.

I am indebted to Dr. G. W. Lougheed, Pathologist to the Wellesley

Hospital, for the careful dissection and examination of the tumour, and the following report :—

Gross Specimen.—Consists of a large tumour mass which is growing in an irregular fashion. There are a large number of grape-like masses projecting from the inner surface of this tumour. They are firm in consistency, whitish in colour,

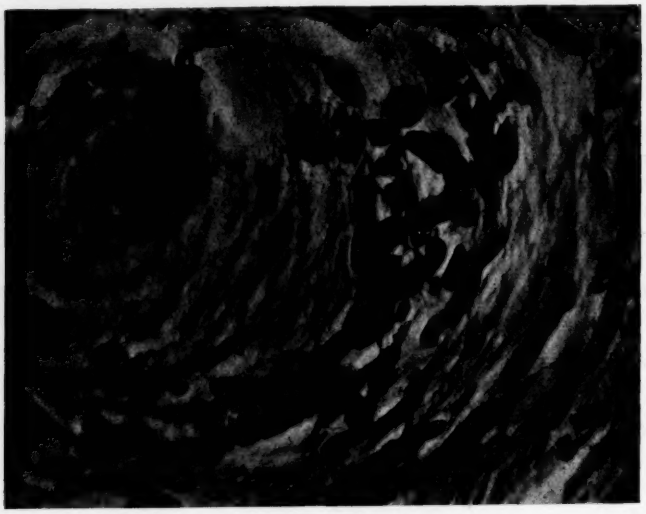

FIG. 195.—Microphotograph showing whorl formation of non-medullated nerve fibres. High dry power × 10 eye-piece ($\frac{3}{8}$ *scale*).

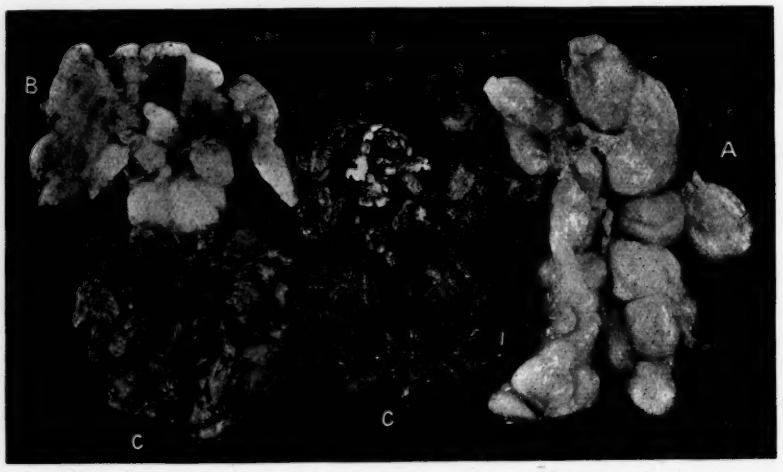

FIG. 196.—A, Dissected portion of tumour showing plexiform arrangement of neurofibromata. B, Cross-section of dissected portion. C. Undissected portion of tumour. Gross tumour measures 5 × 3 × 2½ in. The illustration represents about one-tenth of the tumour, and the nodules are natural size.

and on section have a slight tinge of green. The remainder of the tumour is red in colour, and appears to be covered with a firm thin sheet of fibrous tissue. Beneath this are more of these grape-like masses.

Microscopic Findings.—Slides of some of these nodules show them to be made up of a loose areolar connective tissue with numerous nerve bundles running through

it. There is a fair amount of collagen material present, and in places the tissue is rather œdematous in character. There is no evidence of ganglion nerve-cells present. The majority of the tumour is made up of non-medullated nerve fibres intimately surrounded by fibrous tissue. (*Figs.* 195–198.)

Diagnosis.—Neurofibroma (plexiform).

FIG. 197.—Section of one of the nodules showing nerve bundle present, with surrounding loose areolar connective tissue. Low power × 5 eye-piece ($\frac{2}{3}$ *scale*).

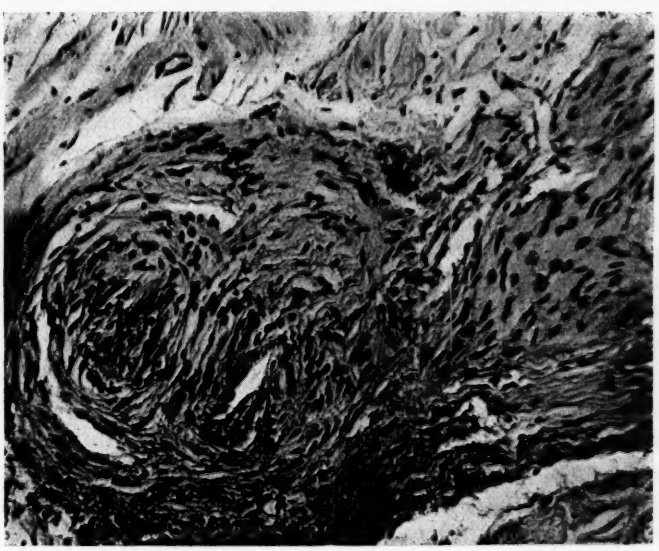

FIG. 198.—Demonstrating whorls of non-medullated nerve fibres, surrounded at top of picture by well-formed fibrous tissue. Low power × 10 eye-piece ($\frac{2}{3}$ *scale*).

The plexiform is the most interesting type of neurofibromatosis. It is a fibromatosis confined to one or more contiguous nerves or a plexus of nerves. The lesion is the same as the more generalized form of neurofibromatosis,

and the two conditions may be met with in the same individual. Although rare, Bruns collected 42 cases, and Thomson 18, which with 2 of his own make a total of 62. It is stated that the tumour may undergo degeneration and may even disappear (Baumgarten), but Thomson agrees with Goldmann that such changes are altogether exceptional. A peculiarity of the plexiform type is the tendency, although involving a purely sensory nerve, to penetrate the adjacent muscles. There may be an overgrowth of subcutaneous tissue and skin in relation to a plexiform tumour which is best described by the term 'elephantiasis', where the skin frequently shows excess of the normal pigmentation. By far the most frequent situation of plexiform neurofibromatosis is the subcutaneous tissue of the head and neck—in the distribution of the trigeminal and superficial cervical nerves—although it may be met with anywhere throughout the sympathetic and peripheral cerebrospinal systems.

The following table is given by Bruns, with additions collected by Thomson :—

SITES OF PLEXIFORM NEUROFIBROMA.

Temple, forehead, and upper eyelid	18 cases
Posterior part of neck and behind auricle ..	14 ,,
Nose and cheek	4 ,,
Region of lower jaw, and anterior half of neck ..	5 ,,
Breast and back	8 ,,
Extremities	9 ,,

The nerves of the extremities include the median, musculospiral, radial, and small sciatic. Goldmann and Pomorski have each recorded a case in which the intercostal nerves were affected, the tumour projecting into the pleural cavity. Bocasso observed a tumour below the jaw, passing along the hypoglossal nerve into the substance of the tongue. Bruns drew attention to the fact that the most common seats of the plexiform neurofibroma are also the most common situations of elephantiasis neuromatosa or pachydermatocele, with which it is frequently associated.

Plexiform tumours are found coexisting with a generalized fibromatosis and with multiple skin-fibromata (molluscum) in about 50 per cent of cases.

Plexiform neurofibroma resembles the elephantiasis with which it is commonly associated, inasmuch as it may be present at birth or develop in early infancy. As to the influence of heredity, a study of the cases demonstrates the fact that neurofibromatosis is sometimes inherited and sometimes met with as a family disease, and gives support to the view that the chief etiological factor in the disease is one which dates from intra-uterine life. Other defects of developmental origin are frequently seen associated with this disease. So far as our present knowledge goes, Bruns, Goldmann, Thomson, and others consider that the condition is a form of giantism or elephantiasis of the connective-tissue elements of the peripheral nervous system.

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DUODENECTOMY.

By CHARLES A. PANNETT, London.

The history of the treatment of chronic gastric ulcers has passed through several stages in its evolution. The greatest advance was made when it came to be recognized that certain penetrating callous ulcers cannot be induced to heal by any known non-operative measures. Surgical intervention was thus proved to be necessary, and various suggestions were put forward as to what the appropriate treatment should be. Accumulative experience gained in clinics the world over has established the pre-eminent position that direct methods must hold over indirect procedures, of which the most commonly practised is gastrojejunostomy. The problem of the treatment of chronic duodenal ulcers is passing through the same phases of study. A very high percentage of successes after gastrojejunostomy has been obtained by Moynihan[1]; but abroad, particularly, a certain dissatisfaction with the results of simple gastrojejunostomy was being felt and expressed in the period immediately preceding the Great War. The essential sameness of the pathology of chronic gastric and duodenal ulcers suggests like remedies, and renders it desirable that the possibilities and results of direct measures should be explored in the case of the duodenum, as in the stomach. In this country very little work has been done in this direction, owing to the good results which have been obtained by gastrojejunostomy; but the results in foreign clinics do not approach them in the degree of success obtained. Thus Bier claims only 66 per cent of cures with simple gastrojejunostomy, but 83 per cent if it is combined with some stenosing operation upon the pylorus. Von Haberer puts his successes after simple gastrojejunostomy as low as 37 per cent, though it must be remembered that he reserves this operation for those cases where excision is impracticable. A number of observers have reported cases where gastrojejunostomy failed to bring about healing in duodenal ulcers, as proved by subsequent operation or autopsy. Haberer saw severe hæmorrhage eight years after gastrojejunostomy combined with pyloric exclusion, whilst O. Maier[2] reports a similar case, where two years later not only were the two original ulcers of the duodenum unhealed, but a new ulcer at the anastomotic margin had appeared.

Examples of failure to cure the symptoms of pain and hæmorrhage after simple gastrojejunostomy for duodenal ulcer could be added to from personal experience, but it must be borne in mind that it will always be possible to collect failures from any method of treatment which falls short of absolute perfection. The crux of the question is obviously the extent to which such failures occur. If our indirect methods are to be displaced by direct ones, it must be proved that the latter give a higher percentage of permanent cures than are reported by the authoritative operators in this country. Opinion seems to have crystallized abroad that radical measures, when they are practicable, are the methods of choice. The aim of this communication is

not to extol the excision of duodenal ulcers as being the best treatment at our disposal, but to popularize the operation of duodenectomy, so that the data may be collected on which we may confidently base our judgement in favour of one or other method.

The history of the operation goes back only a few years. At the German Surgical Congress held at Berlin in 1913, Richter[3] stood alone in recommending excision for duodenal ulcers. The operation had been followed by a very high mortality in most surgeons' hands, so that the radical removal of duodenal ulcers which had penetrated into the pancreas was held to be almost always impossible on anatomical grounds. Von Hofmeister,[4] who was able to report three successful duodenectomies, had injured the common bile and pancreatic ducts in one case, the patient recovering only after a protracted illness and several subsequent operations. He comments upon the difficulty and danger of the method. About 1916, however, attention was again directed to the question, and P. Clairmont[5] gave the first description of a technique for duodenectomy. Finsterer, and particularly Haberer, explored the possibilities of the procedure, and though both Clairmont and Haberer were cautious in their advocacy of the operation and insisted on the careful selection of cases necessary, yet gradually the field of possibility was enlarged, so that, by 1921, E. Nowak[6] was able to report 44 resections, the last 41 of which formed a consecutive series. This means that excision is possible in nearly every case. The degree to which the operation has been exploited abroad is to be gathered from the following statistics: H. Finsterer[7] reports 236 resections with a 3·4 per cent mortality (2 per cent in the last 198 cases), and H. von Haberer[8] 169 resections. Both these authors insist upon the good results obtained, Haberer affirming that they are beyond comparison with those following gastrojejunostomy alone or combined with pyloric exclusion. The few examples cited here are ludicrously small in comparison, and to draw any sweeping deductions from them would be absurd. Yet they illustrate the difficulties of the operation to which all authors refer, whilst the account of the technique employed may prove of assistance to other surgeons interested in this subject.

Two pathological facts assume great prominence when duodenectomy is under consideration. They are the tendency to widespread fibrosis in the neighbourhood of the ulcer, and the frequency with which two ulcers are present. This last occurred five times in my small series.* The first phenomenon is so important because of the nearness of the common bile and pancreatic ducts and their liability to injury unless great care be taken, for they early become surrounded by fibrous tissue which has invaded the gastrohepatic ligament and pancreas. *Fig.* 199 shows the anatomy of the structures in the neighbourhood of the duodenum. In the case of the stomach it is easy to control the blood-supply before resecting, by ligature of the main vascular trunks. But this is not possible in the case of the duodenum, because the pancreaticoduodenal artery conveys blood, not only to the duodenum itself, but to the head of the pancreas. It is therefore necessary to ligate the

* Subsequent experience has shown that the incidence of two ulcers is really greater than here suggested, and that sometimes the posterior ulcer remains unsuspected even after an examination, and is revealed only during the course of the resection operation.

numerous small branches which come off from the vessel and enter the pancreatic wall of the duodenum. This is a tedious and time-consuming procedure, but it must be done with meticulous care, since the obscuration of the area of operation by blood may lead to serious consequences from loss of the power of orientation. There are indeed two main guiding principles in duodenal resection: to keep the dissection close to the wall of the viscus, so that damage to the bile or pancreatic ducts may be avoided; to control the blood-supply by tying the small terminal branches separately.

It is necessary to gain free access to the site of operation. This can be done by a right paramedian rectus-sheath incision with retraction of the muscle. I have not yet found it necessary to supplement this by a cross-section of the rectus as recommended by Haberer and by Nowak. When the abdomen is opened, an impression of impracticability of resection is often first obtained, because periduodenitis is apt to hide the duodenum from view,

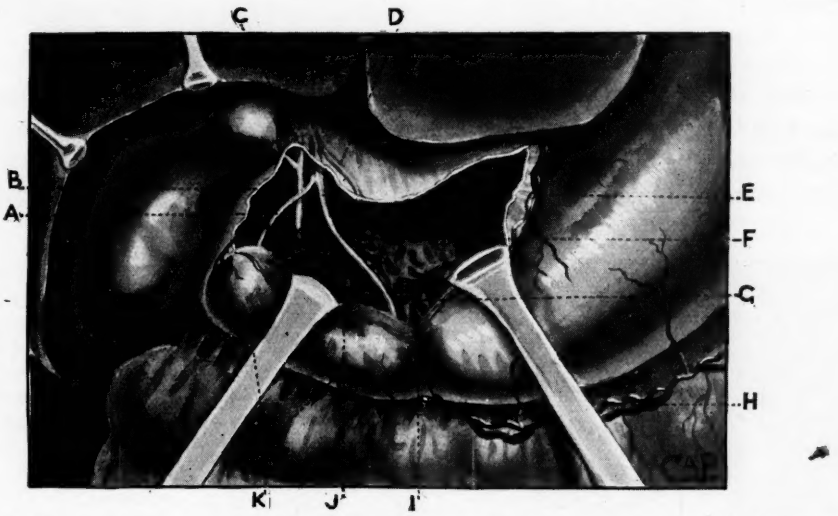

FIG. 199.—The lesser omentum has been divided; the first part and genu of the duodenum have been dissected away from the posterior wall of the abdomen, revealing the relations of it to the pancreas, bile-ducts, and neighbouring vessels. A, Pancreatico-duodenal artery; B, Pancreatico-duodenal vein, joining portal vein; C, Common bile-duct; D, Pyloric artery; E, Coronary vessels; F, Right gastro-epiploic artery; G, Superior mesenteric vein; H, Right gastro-epiploic vessels; I, Pylorus; J, Pancreas; K, First and second parts of duodenum, retracted downwards.

or to shorten it and drag it back to the posterior abdominal wall, to a pronounced degree. Clairmont pointed out how division of these adhesions frees the duodenum in a remarkable way. A surprising elongation of the viscus occurs. When this has been done, it must be decided whether it is possible to proceed without serious risk to the patient. As experience increases, so does the range of operability. I have met with two cases since I have begun resecting duodenal ulcers where I preferred to do a gastro-jejunostomy, because very extensive fibrosis obscured anatomical relations too much; but, as mentioned above, Nowak was able to perform an uninterrupted series of 41 resections. Nevertheless there are contra-indications. If the operator feels that he cannot keep clear of the common bile-duct, if he cannot define it in the gastrohepatic omentum, or if the ulcer extends so far

down that it seems probable that the common-duct papilla has been reached, then he must abandon resection. Nowak affirms that he has never met a duodenal ulcer which reached the biliary papilla; but Finsterer, with his huge experience, recognizes that some cases are not suitable for radical measures. This is only to be expected, for, in the case of the analogous gastric lesion, examples are certainly met now and then when the only possible method of treatment is the indirect one of jejunostomy, as Moynihan has pointed out. If the bile-duct in the margin of the gastrohepatic omentum can be defined, and if the finger and thumb can, by encircling the second part of the duodenum, feel only normal tissue in their grip below the callous mass in the pancreas, and it is reasonably certain that this point is above the opening of the common bile and pancreatic ducts, then the operation can be proceeded with. I think it can be accepted as true that very few ulcers reach down as far as the opening of the ducts in the second part of the duodenum.

THE TECHNIQUE OF RESECTION.

The first step then is to cut through the attachment of the greater omentum just below the pylorus, ligating any vessels in the way. It is usually quite easy to make this separation between the stomach and the right gastro-epiploic vessels, which are then not interfered with. Quite often,

FIG. 200.—The attachment of the peritoneum to the greater curvature of the stomach and duodenum has been divided, opening up a considerable extra-peritoneal space present when the lesser sac does not extend as far to the right as usual. A, Pancreas; B, Branches of pancreatico-duodenal artery; C, Attachment of the great omentum; D, Reflection of peritoneum which forms the right extremity of the lesser sac; E, Right gastro-epiploic vessels.

after this procedure, the lesser sac is not opened as is expected. It is puzzling to find another avascular layer of peritoneum spread out between the stomach and posterior abdominal wall (*see Fig.* 200). This is really the layer forming the right extremity of the lesser sac, perhaps drawn somewhat further to the left by traction on the stomach. If this is penetrated, the lesser sac is entered, and it is then quite simple to make a hole in the lesser omentum just proximal to the pylorus, and pass a strand of gauze round the pyloric segment of the stomach to act as a tractor, as in *Fig.* 201. The freeing of the border of the duodenum which is a continuation of the greater curvature of the stomach is now carried out, every small vessel being ligated before

division. If a director can be passed between the pancreas and duodenal wall below the ulcer, as depicted in *Fig.* 201, it is an immense help in subsequent steps. A ribbon of gauze should replace the director. Separation in the natural plane between the duodenum and pancreas takes place easily where there is no fibrosis. Attention is now directed to the border which is a continuation of the lesser curvature of the stomach. Here the pyloric artery should be defined, and divided between ligatures, and the attachment of the gastrohepatic ligament severed from the stomach. This separation is often one of the most difficult parts of the operation, as the ligament is apt to be transformed into a callous mass. It must always be remembered that the common bile-duct is very close to the bend of the duodenum at this point. It should be defined if possible. I have not been able to do this clearly in every case, but the rule to be followed is simple: Keep close to the duodenal wall and avoid mass clamping or ligations. It cannot be emphasized too strongly that caution is essential at this stage. When the viscus is sufficiently freed, access to the posterior aspect of the duodenum can be better obtained by cutting across the stomach just proximal to the pylorus between clamps. The duodenum can thus be turned over to the right, exposing the pancreas behind and to its medial side (*see Fig.* 202). The tedious business of separating the viscus from the pancreas is now more easily performed. Each branch coming off from the pancreatico-duodenal vessels must separately be doubly ligated before division. A bloodless field is almost an essential. When there is much fibrosis of the head of the pancreas, and the proper plane of separation cannot be accurately determined, it is proper to cut round the margin of the ulcer, leaving the floor in the pancreatic tissue untouched. Escaping duodenal contents should be mopped up. Their dissemination is prevented by the preliminary packing round the area of operation, which is carried out as in any abdominal procedure. Having opened the lumen of the duodenum, it is sometimes difficult to find again the right plane of dissection below the fibrosed area. The search, however, is very greatly simplified if a strand of gauze has been thrown round the distal part of the duodenum as described above. When healthy gut has been reached, it is grasped in the blades of a

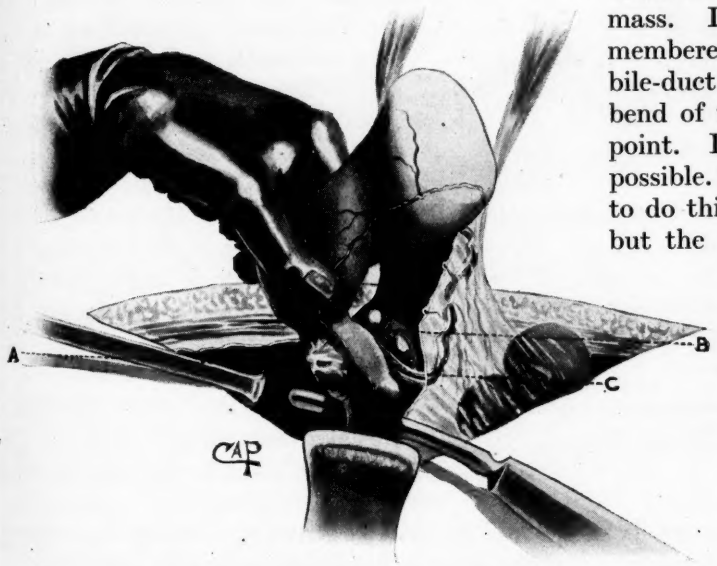

FIG. 201.—The omentum has been separated along its greater and lesser curvatures. A director has been passed between the pancreas and the duodenum distal to the ulcer. A, Liver; B, Pancreas; C, Right gastro-epiploic vessels.

narrow clamp (a long narrow Kocher forceps will do) and cut across, the clamp remaining on the distal segment.

The restoration of continuity of the alimentary canal is brought about usually by axial anastomosis, sometimes by Moynihan's no-loop method of end-to-side gastrojejunostomy. A sufficient amount of stomach having been removed, the axial union is proceeded with as follows. A gastric clamp controls the escape of stomach contents. A duodenal clamp is not used for the same purpose, as it gets too much in the way, and the escape of duodenal contents is not usually too great to be dealt with. The clamp closing the duodenal end is rotated to expose the posterior aspect of the gut, and applied to the stomach as in *Fig.* 203. The posterior seromuscular suture is inserted. The completion of the anastomosis follows ordinary practice. The clamp on the duodenal end is simply removed. The tissue damaged in its grasp is very narrow, does not seem to influence healing, and is not cut away. Owing to the previous compression of the edge, there is very little hæmorrhage from the duodenal stump. Nearly always a part of the lumen of the stomach has to

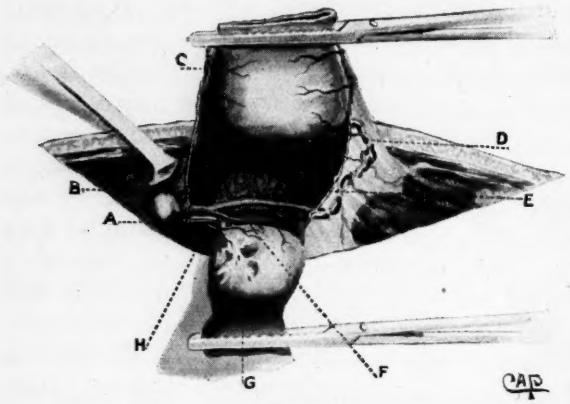

FIG. 202.—The stomach has been cut across just proximal to the pylorus. The pancreatic aspect of the duodenum is exposed, showing branches running into it from the pancreatico-duodenal vessels. Notice the proximity of the common bile-duct. A, Gall-bladder; B, C, Pyloric artery; D. Right gastro-epiploic vessels; E. Pancreas; F, Pancreatico-duodenal artery; G, Pylorus; H, Gastro-duodenal artery, common bile-duct, pancreatico-duodenal vein.

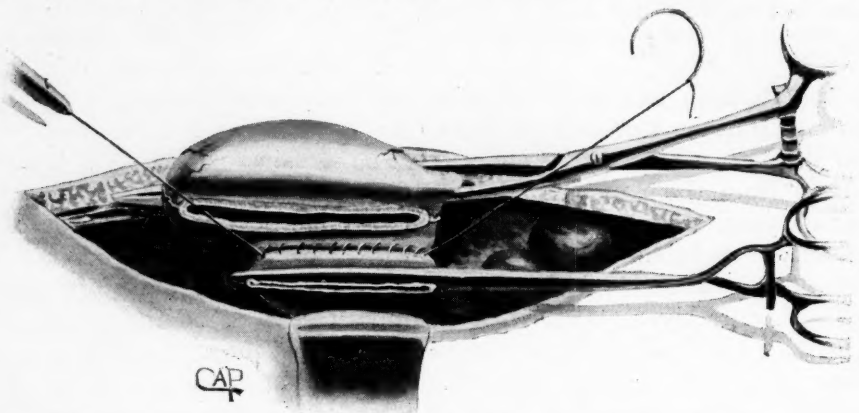

FIG. 203.—First stage in the anastomosis of the stomach to the duodenum.

be sewn up separately to adapt it to the smaller lumen of the intestine, as shown in *Fig.* 204. There has been no trouble at the much-feared dangerous angle. The insertion of the posterior seromuscular suture is sometimes troublesome, but it is important that the suture of the posterior wall of the

duodenum should be carefully and accurately done. Union occurs easily and firmly, as the non-peritoneal surface of the duodenum adheres quickly to the peritoneal-covered gastric surface. In *Case* 2, when the ulcer area had been separated and removed, so little duodenum above the papilla remained for suture that only one layer behind was possible. The convalescence was as smooth and uninterrupted by incident as in any other case. It is quite possible that a single Connell's suture, at least for the posterior aspect, will prove the method of choice.*

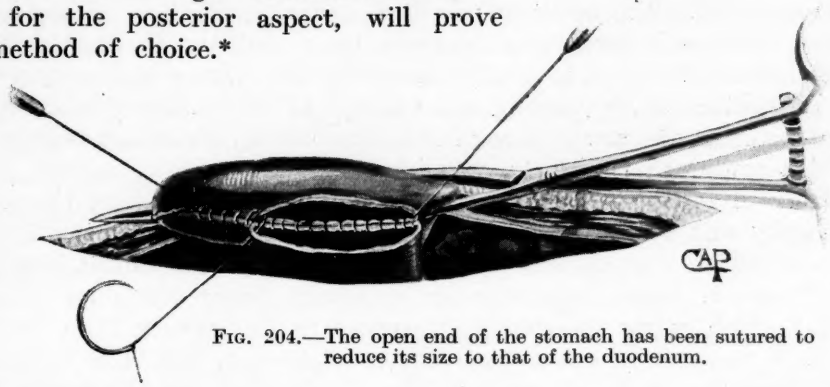

FIG. 204.—The open end of the stomach has been sutured to reduce its size to that of the duodenum.

THE DISADVANTAGES AND DANGERS OF THE OPERATION.

One disadvantage is the length and tediousness of the operation. I have not been able to perform a partial duodenectomy under an hour and a half, and the difficult cases have taken two hours. A simple pylorectomy may be quickly done; but when any considerable length of duodenum is removed, the necessary ligation of so many small vessels consumes much time, whilst when there is a great deal of fibrosis in the neighbourhood every step must be carried out with caution and deliberation. The duration of the operation has had very little noticeable effect upon the patients. The whole procedure is performed with a minimum exposure of the viscera. Usually the small intestine is not seen, and scarcely a glimpse is had of the transverse colon. These viscera remain throughout undisturbed within the abdomen. The anæsthesia during most of the time need be only very light. The statistics quoted above demonstrate how low the immediate mortality may be. Still the operation calls for an unusually sustained effort of concentration and care on the part of the surgeon, and this may be accounted a drawback.

The dangers of the operation are not small. The major one is that of injury to the bile or pancreatic ducts. Injury of the pancreatic ducts is more serious than that of the bile-duct. This subject has been studied by P. Clairmont.[9] He points out that of 7 deaths following duodenectomy, 5 were due to injury of the pancreatic duct, whilst another was due to injury of the common bile-duct. Pancreatic injuries are very fatal, but sometimes recovery occurs after a stormy convalescence and, usually, secondary interventions. The injury is followed by a rapid pulse, high temperature, signs of local peritonitis, abscess formation, fat necrosis, and the appearance of a

* This method has been employed twice since the above was written, with satisfactory results.

pancreatic fistula should the patient survive the first few days. In cases that recover are seen a striking pallor, arrest of convalescence, anorexia, great wasting, and tachycardia. Special tests show pancreatic insufficiency. In one of my patients (*Case* 5) the common duct was cut right across as it lay in the callous mass forming the head of the pancreas. As a papilla was seen in the resected portion of duodenum, it is supposed that the pancreatic duct was severed at the same time, though it was not demonstrable in the area of operation. The common bile-duct is very evident in an accident of this kind, because it gives vent to green bile; but the pancreatic fluid is colourless, whilst the duct is smaller in calibre than that which conveys bile. In this particular case, by turning in the margin of the duodenum and suturing it to the pancreas, the raw surface of this latter viscus, which had been injured and which contained the ducts, was implanted into the open end of the duodenum. A fortunately happy result followed this procedure, the patient getting quite well with comparatively little disturbance of his convalescence.

In connection with this subject certain anatomical facts must be remembered. There is very frequently an accessory pancreatic duct (duct of Santorini) which enters the duodenum nearer to the pylorus than the main duct. In 8 per cent of cases, according to Clairmont, this is of such a size that it forms the main channel for the delivery of the pancreatic juice. Normally the duct of Santorini opens about 4 cm. from the pylorus, whilst the papilla of Vater is approximately 6 cm. from the same point. Often the two openings are much closer together. In 100 cases of duodenal resection reported by the same observer, a pancreatic duct was met with fifteen times. Only by very careful dissection can injury be avoided. If a duct is not larger in calibre than that of a steel knitting-needle, it can usually be ligated and divided, as it is the accessory duct: if larger than this, it must be preserved. Injury of the pancreatic tissue alone, without division of its ducts, may cause complications. Such damage can be prevented by always leaving the floor of the ulcer on the pancreas intact, making no attempt to remove it, and, by careful hæmostasis, avoiding the necessity for passing a number of sutures through the pancreatic substance to control hæmorrhage. Ligation of the pancreaticoduodenal artery at a single point can be done apparently without any harm resulting. In one of my cases I had to ligate the trunk of the corresponding vein. There were no ill effects.

THE PLACE THAT DUODENECTOMY SHOULD ASSUME IN THE TREATMENT OF DUODENAL ULCER.

Should resection of the duodenum displace gastrojejunostomy as the method of choice? The answer to this will depend partly upon the end-results obtained, and partly upon the as yet unproved point as to whether the increased advantage gained, should such be proved, is commensurate with the added risk of the operation. The operative mortality has been brought down to a figure not very much greater than that of simple gastrojejunostomy (v. Haberer 3·5 per cent in 169 cases, H. Finsterer 2 per cent in last 198 cases). We still await more reports of late results. Haberer regards them as very much more satisfactory than those following any indirect

method. It is essential that experience of the operation in this country should be accumulated to come to a decision on this question. Finsterer[10] regards resection as the method of choice. He claims, after five years or longer, 93·6 per cent absolute cures in 63 cases when the duodenum and one-half of the stomach were removed. However, he stresses the technical difficulties of it, and indeed has published a series of cases where, in preference to attempting resection, he performed exclusion of the pylorus and gastro-jejunostomy, with removal of the whole of the pyloric section of the stomach,[11] obtaining thereby 84·8 per cent two-year cures in 33 cases.

One other problem in connection with the operation remains to be decided, namely, the amount of stomach which it is advisable to remove at the same time as the affected duodenal segment. Some surgeons divide the stomach across, just proximal to the pylorus, whilst others, who follow the teaching of Finsterer, remove two-thirds or four-fifths of the stomach, by which means they permanently reduce the digestive power of its secretion and claim to remove the tendency to ulcer formation.

CASES.

Case 1.—D. H., male, age 40. Indigestion in attacks, with free intervals, for nineteen years. Pain three to four hours after food, relieved by the next meal. Vomiting occurs. Attacks getting more frequent and longer in duration.

Barium Meal.—Deformity persistent in first part of duodenum: some delay in emptying time.

Operation.—Aug. 28, 1923. Paramedian laparotomy with retraction of the rectus muscle. An ulcer present on upper wall of first part of duodenum, extending round to the posterior wall. A good deal of fibrosis present, extending into pancreas. Greater curvature of stomach dragged over and adherent to second part of duodenum. Preparation of duodenum and excision of the affected portion with axial anastomosis in ordinary way.

Convalescence smooth.

Case 2.—F. W., male, age 33. Indigestion for many years. Pain has no relation to food, but is worse if intervals between meals are longer than usual. No vomiting. Two weeks ago awoke with severe abdominal pain, which was followed by copious melæna and by fainting.

Barium Meal.—Shows a persistent irregularity of first part of duodenum, and a residue in stomach five and a half hours after the meal.

Operation.—Oct. 18, 1923. Paramedian laparotomy with retraction of the rectus muscle. A puckered ulcer on anterior wall of first part of duodenum, and a large one behind in second part, penetrating the pancreas. Preparation of duodenum according to usual technique. Stomach cut across just proximal to pyloric sphincter. In separating the second part of duodenum, the lumen had to be penetrated by cutting round the margin of the ulcer on the pancreas. When normal duodenal wall was reached again, it was found that there was only sufficient to put in one row of sutures. Axial anastomosis between duodenum and stomach was therefore performed, using one layer of penetrating sutures behind and the usual two layers of sutures in front.

Convalescence proceeded without incident.

Case 3.—E. C., male, age 42. Twelve years' history of indigestion with remissions. Complaints much worse for last six months. Pain one to two hours after food. Vomiting occurs and relieves the pain. Exploration eight years ago in another hospital, but no lesion of stomach or duodenum found.

Barium Meal.—Deformity of first part of duodenum. Small shadow persists here after stomach is empty.

OPERATION.—Oct. 31, 1923. Median laparotomy through old scar. A large mass present in posterior wall of first part of duodenum, extending down to second part. A large ulcer crater could be felt by invaginating the anterior duodenal wall with the finger. Much fibrosis of head of pancreas. Mesocolon dragged up in a fold and adherent to the mass. Much thickening of the gastrohepatic ligament. Separation of lesser and greater omenta from prepyloric region of stomach. Division of stomach 1½ in. proximal to pylorus. The duodenum was then separated from the fibrotic pancreas and gastrohepatic ligament, the floor of the ulcer being left attached to the pancreas, which necessitated incising into the lumen of the duodenum around the margin of the ulcer. Suture of duodenal stump. Anastomosis of open end of stomach to the first part of jejunum by Moynihan's technique.

Convalescence smooth.

Case 4.—H. P., male, age 36. Indigestion for eighteen months in attacks, with free intervals. Hunger pains.

BARIUM MEAL.—Stomach hypertonic, but there is delay in emptying time. Shadow of bulb indistinct. Pylorus more to right than usual.

OPERATION.—Nov. 29, 1923. Paramedian laparotomy with retraction of rectus muscle. An ulcer present on anterior wall of first part of duodenum. Mobilization of duodenum by usual technique, followed by excision of affected part together with the pylorus, and end-to-end anastomosis. This operation was performed without difficulty, as infiltration of the pancreas and gastrohepatic ligament was absent.

Case 5.—F. G., male, age 55. Nine years' history of pain and vomiting after food (four to five hours). The indigestion has been continuous, with no completely free intervals.

BARIUM MEAL.—Findings not distinctive ; delay in emptying time.

OPERATION.—Jan. 9, 1924. Paramedian laparotomy with rectus muscle retraction. The following pathological condition was found at operation : scar on anterior wall of stomach, about 1 in. from pylorus ; large penetrating ulcer of duodenum on posterior wall at junction of first and second parts, spreading into pancreas ; cicatricial contraction of wall of duodenum opposite to the ulcer, giving rise to deep constriction. The duodenum was prepared in the usual way, but in an attempt to remove the duodenum without opening its lumen the common bile-duct was cut right across. It is believed that the main pancreatic duct was also severed—though it could not be identified in the sclerotic mass without further dissection—because, in the section of the duodenum removed, the papilla was seen. A tube was inserted up the common bile-duct and introduced into the open end of the duodenum. The cut surface of the pancreas containing the severed ducts was implanted into this open duodenal end. The stomach was anastomosed to the jejunum, though a certain length of loop was left, as there were adhesions between the first part of the jejunum and the under surface of the transverse mesocolon.

On the fourth day the temperature rose to 101°, and on the fifth jaundice appeared, but the temperature had fallen to normal. It never rose again. By the ninth day the jaundice had disappeared, and from this date convalescence proceeded without incident.

Case 6.—J. B., male, age 45. Indigestion for five years, with intervals free from trouble, but which have gradually become shorter in duration. Pain occurred usually one hour after food. Vomiting from time to time.

BARIUM MEAL.—Much delay in emptying time of stomach ; eight-hour residue considerable. Deformity of prepyloric shadow, and a persistent fleck in region of first part of duodenum. Cap never seen properly filled.

OPERATION.—Jan. 10, 1924. Paramedian laparotomy with retraction of rectus muscle. Puckered ulcer on upper wall of first part of duodenum, just beyond the pylorus, with much infiltration of gastrohepatic ligament. A number of adhesions between gall-bladder and second part of duodenum. Pylorus and first part of duodenum excised according to usual technique. There was a broad adhesion between posterior aspect of pylorus and pancreas. Axial anastomosis between stomach and duodenum.

Convalescence complicated by bronchitis during first few days following operation ; otherwise satisfactory.

Case 7.—H. S., male, age 30. History of indigestion with intervals of complete freedom for more than two years. The pain appears regularly about four hours after food. Pain made worse by exercise. Occasional vomiting.

BARIUM MEAL.—Irregularity of pyloric shadow. Small four-hour residue.

OPERATION.—Jan. 31, 1924. Paramedian laparotomy with retraction of rectus muscle. Ulcer on anterior wall of first part of duodenum, and another on posterior wall at beginning of second part. Considerable fibrosis of pancreas in neighbourhood of posterior ulcer. Duodenum freed by usual technique to a point beyond the situation of the ulcers, where it was cut across. Stomach divided 1½ in. proximal to pylorus. End-to-end anastomosis of stomach to duodenum without clamps.

The bronchitis detectable before operation was lighted up, but the signs in chest had disappeared by the fifth day after operation. Convalescence otherwise uneventful.

Case 8.—C. L., male, age 44. Attacks of severe indigestion, with free intervals, began six and a half years ago. The pain bears no constant relation to the taking of food. Vomiting occurs during the attacks. No hæmatemesis or melæna, and appetite good.

BARIUM MEAL.—Stomach empties in average time. It is hypertonic. Duodenum not visualized distinctly. Ulcer of lesser curvature suggested.

OPERATION.—March 13, 1924. Paramedian laparotomy with retraction of rectus. When the abdomen was opened, the duodenum was found to be completely embedded in adhesions, binding to it the gall-bladder, omentum, and hepatic flexure of the colon. After separation of these adhesions, there were found to be a white scar on anterior wall of first part of duodenum ; a large ulcer on posterior wall, adherent to pancreas ; a stricture of the second part of duodenum ; and much infiltration of the gastrohepatic ligament. By the usual technique the affected segment of the duodenum was excised and joined axially to the stomach.

Convalescence uneventful.

Case 9.—G. F., male, age 29. Four years ago had severe attack of abdominal pain with vomiting. Ever since he has had constant indigestion, with only a few weeks' relief. Pain two hours after food, followed by vomiting. No hæmatemesis.

BARIUM MEAL.—Duodenum never seen properly filled ; six-hour residue considerable.

OPERATION.—March 20, 1924. Paramedian laparotomy with retraction of rectus muscle. Small ulcer on anterior wall of first part of duodenum and large sclerosed mass on posterior wall. Two adhesions between gall-bladder and duodenum. Stones felt in gall-bladder. Duodenum prepared in usual way, and ulcer-bearing area excised. End-to-end anastomosis between duodenum and stomach, which was cut across about 2 in. from pylorus. Gall-bladder opened and three stones removed. Tube sewn into gall-bladder.

Convalescence smooth. Bile drainage lasted for eighteen days.

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PAGET'S DISEASE OF THE NIPPLE.

By Sir GEORGE LENTHAL CHEATLE, London.

By describing the whole sections of the breast suffering from Paget's disease of the nipple (*Fig.* 205), I add the ninth to those eight separate specimens already published in my paper entitled "Paget's Disease of the Nipple", which appeared in The British Journal of Surgery, Vol. XI, No. 42, 1923. It will be seen that the present example demonstrates the same problems as those I described in the previous specimens.

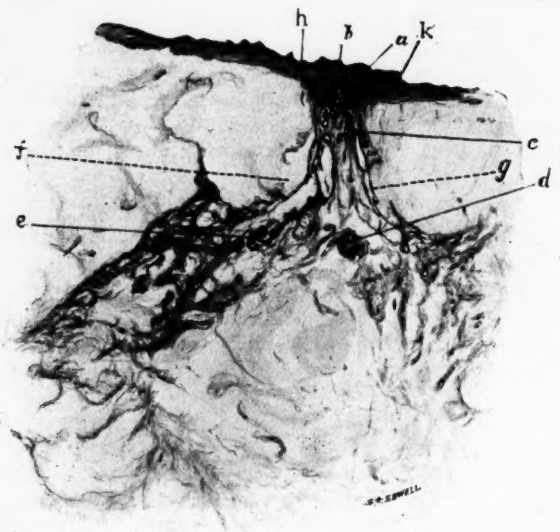


Fig. 205.—Whole section ($\frac{3}{4}$ natural size) of breast suffering from Paget's disease of the nipple, *a*, extending between the lines *h* and *k*, in a female, age 46, married; *b* is the duct in *Fig.* 211; *c* is the duct in *Fig.* 206; *d* is a lobule in *Fig.* 208; *e* is a lobule in *Fig.* 210. The dotted lines at *f* and *g* indicate lobule sections of the same breast situated deeper in the gland than *Fig.* 205, but which have not been reproduced here; *f* refers to ducts and acini in *Fig.* 209, and *g* to a terminal duct *a* in *Fig.* 207, which leads into the lobule in *Fig.* 208. There were no enlarged axillary lymphatic glands.

There are in this specimen different varieties of primary carcinoma. For instance, in direct continuity with Paget's disease on the surface is the primary carcinoma in the duct (*Fig.* 206), which, in its structure, has no characteristics of Paget's disease of the nipple. After appearing as a primary duct carcinoma, there is an interval in which the duct is free from disease until one of its terminal branches is reached at *Fig.* 207, where carcinoma of the duct is again obvious, and the duct terminates in a lobule the epithelium of which has

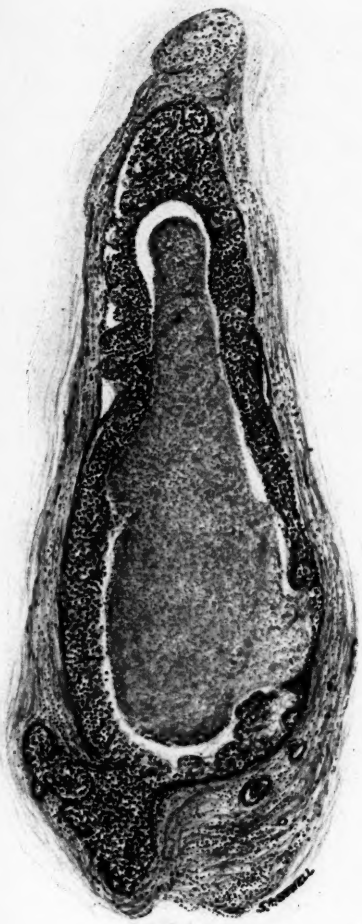


FIG. 206.—Carcinoma of duct *c* in *Fig.* 205. In other sections the epithelial cells have profoundly invaded the duct walls.

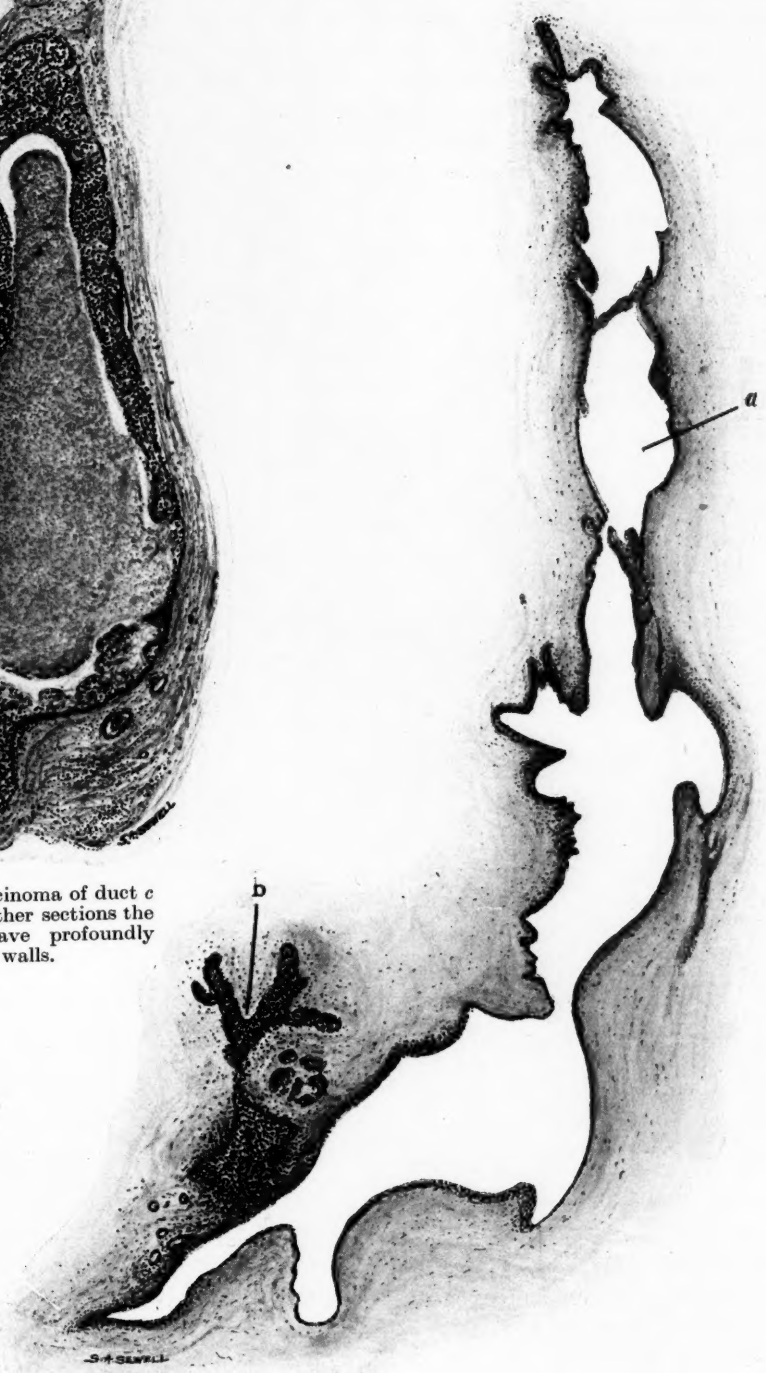


FIG. 207.—A main duct in which one of its terminals, *a*, contains duct carcinoma and leads into the lobule in *Fig.* 208. The duct is a deeper part of the duct *g* in *Fig.* 205. Carcinoma is also seen at *b*.

undergone conversion into primary acinous carcinoma (*Fig.* 208). In another duct (*Fig.* 209) is seen another primary duct carcinoma, more papillomatous in type than that in *Fig.* 206. There is acinous carcinoma in *Fig.* 210.

There is another example of similarity between this specimen and those previously published; take the duct *c* in *Fig.* 205, which is part of the duct *a* in *Fig.* 207. A long interval of the duct is free from disease, which reappears in a terminal branch of it at *b* in *Fig.* 207. The distribution

FIG. 208.—The carcinomatous lobule into which the carcinomatous duct *a* in *Fig.* 207 leads, and corresponding to *d* in *Fig.* 205.

of disease in this duct is similar to that I described in this journal, Vol. XI, No. 42, *Fig.* 216, in which only the upper and terminal parts of the duct were carcinomatous.

My explanation of these facts is that the same agents that induced the primary carcinoma in the upper parts of these ducts found an easy pathway in the dilated main ducts, and were arrested in the terminal branches, where they were able to act undisturbed.

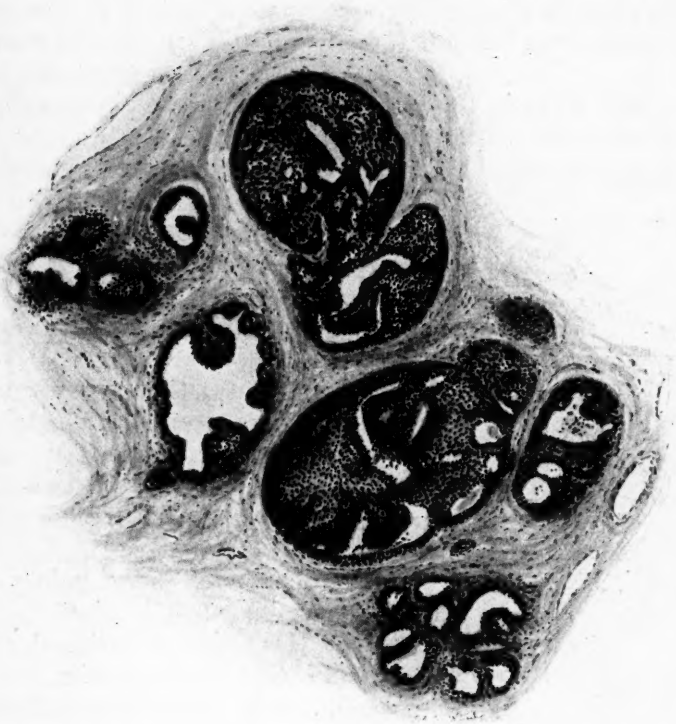


FIG. 209.—A small collection of carcinomatous terminal ducts and acini from *f* in *Fig.* 205. The epithelial cells in the ducts are infiltrating surrounding tissues.

FIG. 210.—A carcinomatous lobule the exact duct connection of which I was unable to trace. The lobule is seen at *e* in *Fig.* 205.

Fig. 211 is a higher magnification of the upper part of a duct at *b* in *Fig.* 205. Nearly all of the epithelium lining half of the duct has undergone malignant change at *a*.

The main problem that arose in the eight specimens previously described is apparent in this ninth specimen, i.e.: Can Paget's disease of the nipple be described as a primary lesion and the changes in the breast as secondary? Or, can these changes be described as primary and Paget's disease of the nipple secondary? Or, can Paget's disease of the nipple and changes in the breast have no connection with each other?

FIG. 211.—The duct *b* in *Fig.* 205. Nearly all the epithelium has undergone carcinomatous change (*a*) in one half of the duct's circumference.

I have no doubt that the changes in the breast are secondary to the Paget's disease of the nipple, for many reasons. For fuller information on these points, see my article referred to above.

There are three more points to which I must allude:—

1. That there was no clinical sign of disease in this breast. The breast lesions could only have been detected by making microscopical sections of the whole breast.

2. In all the lesions I describe, the epithelial cells are not desquamative in type, but they are vigorous looking cells which—like carcinoma cells—are living an independent existence and are not attached to any connective tissue base, through which other epithelial cells have spread in many parts.

3. In the connective tissue subjacent to the Paget's disease of the nipple, there are no lymphatic vessels containing carcinoma cells. The carcinoma in the breast is too early for this occurrence. Hence lymphatic vessels containing carcinoma cells can have nothing to do with the origin of the Paget's disease of the nipple.

THE TRANSPLANTATION OF THE FIBROUS TISSUES IN THE REPAIR OF ANATOMICAL DEFECTS.*

By W. E. GALLIE and A. B. LeMESURIER, Toronto, Canada.

Among the advances which have been made in the science of surgery in the past ten years the transplantation of tissues from one part of the body to another has been one of the most important. Skin-grafting is an operation which has been studied thoroughly and which has proved of the utmost value in the treatment of wounds. The transplantation of bone has been a splendid addition to our means of promoting union in fractures, although the hopes of investigators that the transplants would continue to live intact have been doomed to disappointment. Transplanted bone dies because the bone-cells are so remotely placed in their lacunæ that it is impossible for lymph to reach them. Only those cells which lie on the surfaces of the transplant and in the open mouths of the Haversian canals and which have not yet become enclosed in lacunæ continue to live. Fortunately, the success of a bone-graft does not depend altogether on the survival of the cells, and despite the fact that most of the graft dies, it still serves as a valuable assistant in bringing about union in fractures. In the case of the fibrous tissues, however, there is no such peculiar arrangement of the cells within impermeable walls. They lie irregularly scattered among the fibres and are so accessible that even after transplantation of the tissue they are able to get sufficient nourishment from the bathing lymph to survive the operation. Many investigators have reported that these tissues may be transplanted with the full expectation that they will continue to live, and to live practically unchanged.

Before embarking on the investigation which forms the basis of this paper, we conducted a series of simple experiments on animals which completely corroborated the findings of these investigators. The animals used were rabbits, and the experiments consisted of operations in which patches of fascia, tendon, and aponeurosis were excised and immediately sewn back in their original positions. The specimens were recovered at intervals ranging from a few days to many weeks.

During the first few weeks the specimens showed the ordinary phenomena of inflammation. At first the blood-vessels in the tissues surrounding the transplants were much engorged and the whole area was covered with plastic exudate. Very soon a thin transparent film developed over the transplant, consisting of capillary blood-vessels and fibroblasts. This film rapidly

* The Hunterian lecture delivered at the Royal College of Surgeons of England on April 30, 1924, by W. E. Gallie, was based on the material contained in this paper. The experimental investigations involved were conducted in the research laboratories of the University of Toronto.

increased in thickness, and, by the end of the third week, had developed into a mass of spindle-shaped cells and fibres. The blood-vessels in this film increased in size at a corresponding rate until they could be seen with the naked eye, running across the line of suture. During this time the transplant remained alive, and showed, on microscopic examination, very little change beyond a moderate œdema. Its outline remained distinct, without any evidence of invasion by new blood-vessels or connective tissue and without any leucocytic infiltration. The fibres and cells continued to stain well. (*Figs.* 212, 213.)

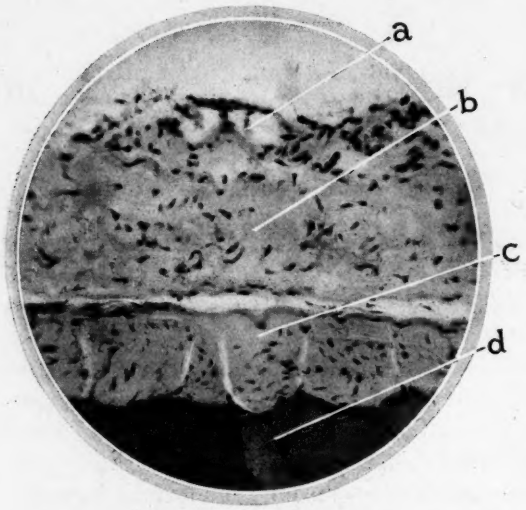


FIG. 212.—Normal fascia and aponeurosis from rabbit's back, showing arrangement of fibres and cells. (High power.) *a*, Vascular areolar tissue on surface; *b*, Deep fascia of back; *c*, Aponeurosis; *d*, Muscle.

After the third week the inflammatory phenomena gradually subsided. The hyperæmia and œdema slowly disappeared, and the film on the surface became as thin and transparent as the layer of areolar tissue on the surface of normal fascia. In specimens recovered as late as a year after the operation there was nothing to indicate that the cells or fibres had been changed in any way or that their physiological value had been influenced by the transplantation (*Fig.* 214).

These experiments were repeated many times, and always gave the same results, with the exception that when thick pieces of tendon were transplanted necrosis sometimes occurred in the deeper portions. This can be prevented by making a number of longitudinal incisions in the transplant through which the lymph may reach the cells in the interior.

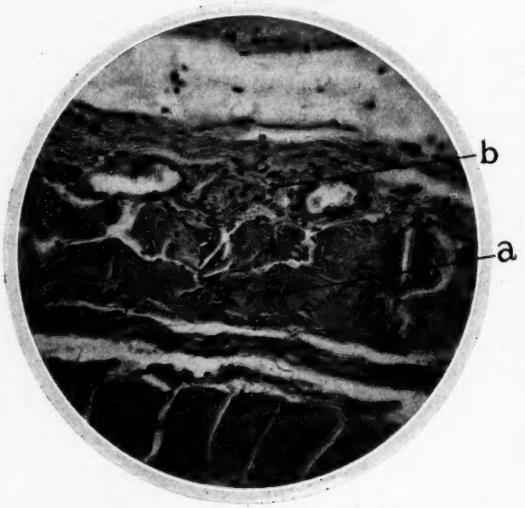


FIG. 213.—Fascial transplant recovered after three weeks. (High power.) *a*, Fascial transplant; *b*, Thick film of very vascular new areolar tissue on surface.

Thoroughly convinced that the fibrous tissues are suitable for transplantation and that they can be expected to remain unchanged for long periods of time, we turned our attention to a study of the purposes for which they may be transplanted, and of the manner in which the operations must be performed to ensure the

desired results. From time to time reports of successful transplantations of fascia lata for the repair of anatomical defects have appeared in the medical literature, but as far as we know there have been no investigations of how these successes were accomplished, and no statement of the rules which must be adopted to avoid the possibility of failure. That failures occur is unfortunately true, and they have been so frequent that the transplantation of fascia has never come into very general use. In the treatment of large ventral hernias and of direct inguinal hernias, for example, the filling of the defects with patches of fascia lata has been often described; and yet one rarely hears, nowadays, of the operation being performed.

The failures have been attributed usually to the supposed necrosis and absorption of the grafts. This explanation may in some cases be perfectly correct, for it is easy to imagine that if the transplants are placed in such a position that a free supply of lymph is not available, as, for example, in a mass of scar-tissue, necrosis and absorption might occur. The perfect regularity, however, with which success is attained in experiments on animals, and the practically complete absence of failures which has attended our own clinical work, have led us to believe that necrosis of the transplant is not the real explanation of failure.

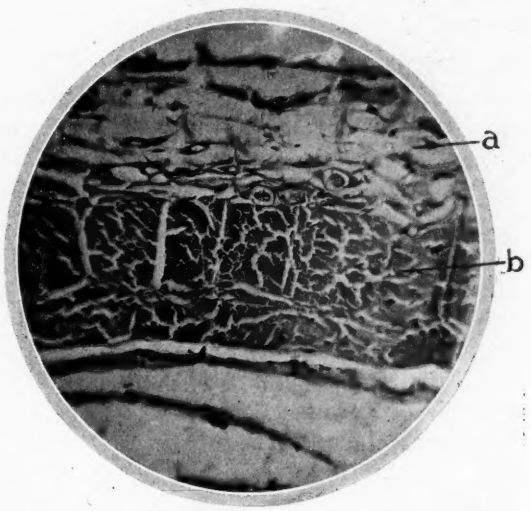


FIG. 214.—Fascial transplant recovered after thirteen months. (High power.) *a*, Areolar tissue on surface with normal blood-supply; *b*, Fascial transplant.

Some years ago, in a study of the fixation of tendons to periosteum and bone, we were struck with the amount of precaution which must be taken to secure an adhesion of one structure to the other sufficiently strong to withstand ordinary physiological strain. We found that in attempting to prevent the deformities of infantile paralysis in the feet by fixing the tendons of the paralysed muscles to the bone, it was necessary to bury the thoroughly scarified tendon in a groove or tunnel for a considerable distance before solid union could be assured. Further, the surfaces of the tendon must be held firmly in contact with the walls of the tunnel for six or eight weeks. If any of the details of the operation were neglected, such as the complete removal of the areolar coverings of the tendon, and the scarification of its surface, failure of the fixation was the invariable result. Histological examination of specimens recovered at a later date clearly showed that the fixation of the tendon to the bone depended solely on scar-tissue, and that unless this scar-tissue were continuous with the connective tissue in the interior of the tendon, through wounds produced in its surface, and unless the section of tendon buried in the bone were from one to three inches in length, depending on the strain to

which the tendon would be subjected, the scar-tissue always gave way or stretched, and the deformity recurred. These observations caused us to suspect that the failures following the transplantation of tendon and fascia might be accounted for in a similar way, and ultimately led to a series of experiments on animals which have amply confirmed the suspicion.

The first series of experiments was concerned with the simple healing in the fibrous tissues. Incisions were made longitudinally and transversely in tendon, fascia, and aponeurosis, and sutured in various ways with catgut and fine silk. The specimens were recovered at intervals. When the line of incision was subjected to very little strain, as in the longitudinal splitting of a tendon or of the fascia lata, the wound healed perfectly, and in a few months could not be found either by naked-eye or microscopical examination. When the ordinary movements of the animal, however, caused a strain upon the line of incision, very different results were produced. Sometimes, as in longitudinal incisions in the middle line of the abdomen, the scar which formed was only slightly stretched. In others, as in transverse incisions through tendons and aponeuroses, the wound gave way completely and was covered only by the stretched-out areolar membranes which are normally on the surfaces of these structures. If the edges of the incision were simply drawn together into edge-to-edge apposition with an absorbable suture, the tendency to separation was greatest; but even when silk was used, although the amount of scar-tissue was increased, the stitches frequently cut out and the wound stretched open. This tendency to opening of the wound was very decidedly lessened by scraping off the areolar sheaths, and overlapping the edges. The scraping of the surfaces was of the utmost importance, as without it the simple overlapping did no good whatever. Microscopical examination showed that when the sheath was scraped away the overlapped edges healed by a scar which was intimately attached to them, whereas, when the areolar tissues were left in place, the healing simply consisted of a light adhesion of the areolar tissue on one edge of the wound to that on the other. Even when these precautions were taken, however, if the wounds were subjected to severe or long-continued strain they frequently opened up.

These observations made on animals agree fully with clinical experience. Examples of defective healing in wounds of the fibrous tissues are readily available. Thus, subcutaneous tenotomy, which at one time was very generally employed, has been demonstrated to be a dangerous operation owing to the tendency of the scar which forms between the ends of the tendon to stretch. It has been replaced, almost completely, by some other form of tendon-lengthening. The frequency of hernia through incisions in the linea semilunaris has forced the abandonment of this approach to the abdominal cavity. And the uncertainty attending attempts to close large umbilical and post-operative ventral hernias is too well known to admit of doubt in regard to the nature of the healing.

A second series of experiments was devoted to a study of the character of the healing which takes place between transplants and the tissues to which they are sewn. In one group patches of fascia were removed from the animals' backs and sewn into place again by the various methods used in everyday surgical practice. In another group segments of tendon were cut free and

similarly replaced. The specimens were recovered as before at regular intervals up to many months.

A study of the specimens obtained in these experiments confirmed completely our suspicions as to the cause of failures after transplantation of the fibrous tissues. Healing of a transplant to the tissues to which it is sewn takes place exactly as in the healing of a simple wound of the fibrous tissues. The fact that the transplant has been cut free from the circulation appears to have no influence on the character of the healing. If the line of contact is under only slight tension satisfactory union occurs, but if the scar is subjected to prolonged or severe strain the line of suture opens up and the final result is a failure. Simple edge-to-edge suture of fascia or aponeurosis and end-to-end suture of tendon give the highest percentage of failures. Careful scraping and overlapping of the edges which are in contact greatly increase the strength of the union, but even here the success of the operation depends entirely on the strain to which the line of suture is subjected. Non-absorbable sutures add to the strength of the union by increasing the amount of scar tissue and by supporting part of the strain themselves, but, as in the case of simple wounds, they frequently cut out and the same result follows as when absorbable sutures are used. (*Figs.* 215, 216.)

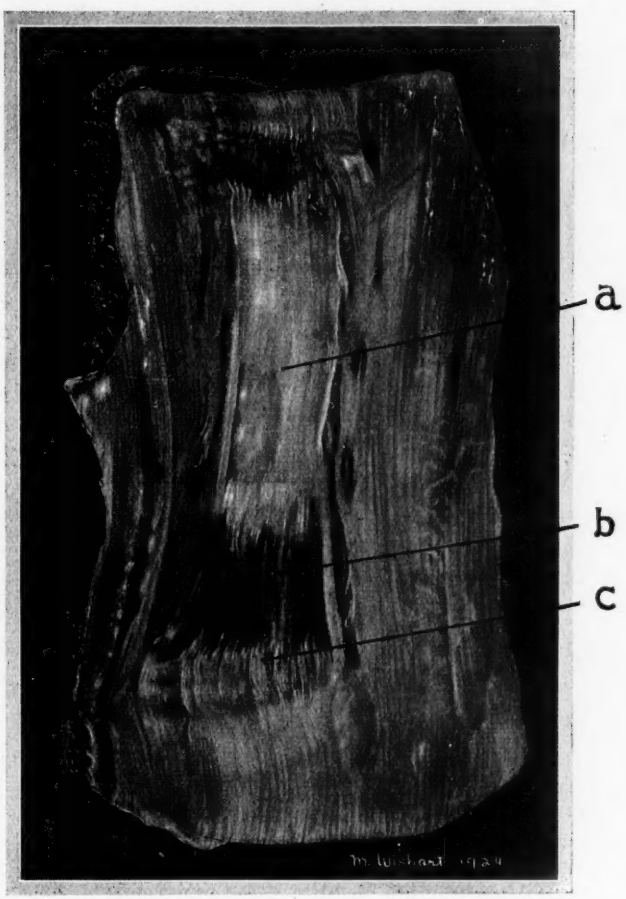


FIG. 215.—Drawing of patch-transplant of aponeurosis recovered after thirteen months. At the operation the transplant was accurately sutured all around its edge to the normal aponeurosis. Union has taken place by the formation of weak scar-tissue which has stretched considerably. *a*, Aponeurotic transplant; *b*, Thin film of new tissue uniting *a* and *c*; *c*, Edge of normal aponeurosis.

In a third series of experiments we investigated the healing of transplants of tendon and fascia to bone. The results indicated that the nature of the healing is exactly similar to that which occurs when a tendon is transferred to a new insertion. If the transplant is simply sewn to the periosteum, or placed under it, or laid in a groove in the bone for a short distance, it very soon pulls away after strain is applied, owing to the weakness of the scar-tissue which forms the bond of union. To make certain of a permanent

fixation it is necessary to scarify the surface of the transplant and to place it in close apposition with raw bone for a considerable distance, from one to three inches, depending on the anticipated strain. If it is intended to bury the tendon in a groove, the most certain method of fixation is to split it into several tails and to pack it into the groove along with slivers of the bone removed with the gouge. The periosteum is sewn over all. In this way the surfaces to which adhesions will take place are greatly increased and the scar-tissue is carried into the depths of the transplant. The most generally useful method of fixation, however, is to pass the end of the transplant, which has been split into tails, through a drill-hole in the bone, and to fix it there by some form of absorbable suture which will hold it in place till healing occurs.

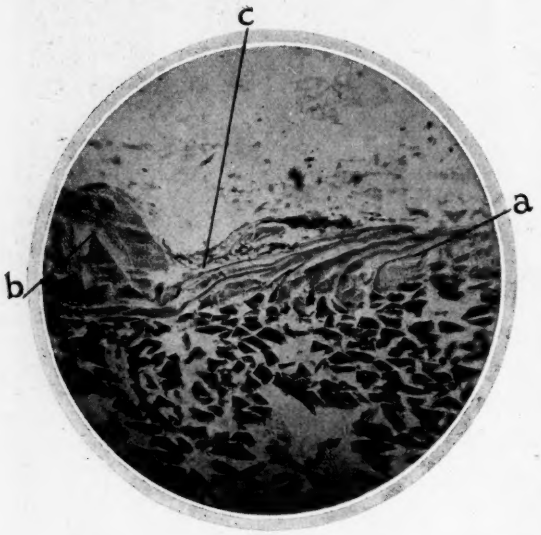


FIG. 216.—Line of union between aponeurotic transplant and normal aponeurosis after thirteen months. (High power.) *a*, Aponeurotic transplant; *b*, Normal aponeurosis; *c*, New scar-tissue between the two.

These simple experiments have been useful in fixing our attention on the weak point of the usual methods of filling anatomical defects with transplants of the fibrous tissues. Evidently edge-to-edge suture of aponeurosis or fascia should only be done where the tissues can be brought together without tension, and where the subsequent physiological strain will be slight. It will be rare indeed to find an occasion in which this method will be useful in sewing in a transplant. The experiments indicate that, in practically all cases where transplants are required, it is necessary to overlap the edges freely and to scrape and scarify the surfaces which are placed in apposition, before firm healing can be expected. Silk or linen would appear to be the suture material of choice.

The objections to these refinements of technique are considerable. In the first place, many surgeons, in common with ourselves, hesitate to use non-absorbable sutures owing to the frequency with which they set up late irritation. In the second place, the operation is made long and difficult, and the additional handling of the tissues adds to the chances of infection of the wound. And, lastly, the precautions by no means eliminate the possibility of separation of the wound, as, after all, the union is dependent on scar.

In thinking over various means of getting rid of these objections, it occurred to us that it might be possible to eliminate the patch-transplant altogether, and replace it by living sutures made from fascia lata. To test this idea, a series of experiments was performed in which strips of fascia a quarter of an inch wide and about six inches long were removed from the rabbits' backs, and, after being threaded on a needle, were used to sew together

the edges of the gap left by their removal. The edges were not drawn into apposition but were left apart, so that the whole strain would come on the suture and not on any scar-tissue which might form in the line of union. To test the effect of the operation on the strength of the sutures, we made a rough estimate, by means of a special machine, of their tensile strength at the time of the operation and again when the specimen was recovered. We also studied the question of stretching or contraction of the suture by attaching to it at accurately measured intervals two black silk threads to act as markers. The distance between these markers was measured again when the specimen was examined. The specimens were recovered at intervals from a few days to two years after the operation.

FIG. 217.—Drawing of living suture of fascia, recovered three weeks after its insertion in rabbit's back. On the upper stitch are shown the two black silk markers used to test the effect of the operation on the length of the suture. Dilated blood-vessels can be seen traversing the area in the areolar film which forms over the suture.

The changes which occurred in the sutures agreed accurately with those already described in the case of patch-transplants. A few days after the operation the surrounding tissues were hyperæmic and the whole area was covered with a thin layer of exudate. The suture was distinctly swollen. At the end of a week minute new blood-vessels could be seen spreading through the film on the surface of the suture; these increased in size until towards the end of the third week, by which time the film of exudate had been converted into ordinary areolar tissue. As a result of following the needle through the needle-holes the suture had been folded longitudinally. It was completely surrounded by the new film of areolar tissue, which sent processes with new blood-vessels between the folds. A cross-section made at the end

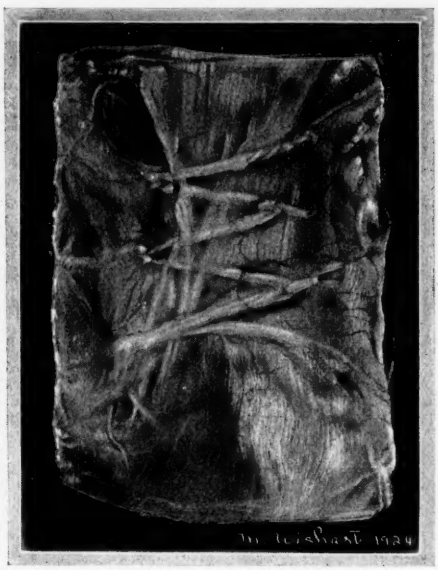


FIG. 218.—Drawing of living suture of fascia, recovered thirteen weeks after insertion in rabbit's back. The suture is now a rounded glistening cord which closely resembles tendon.

of the third week shows the suture folded loosely together and completely surrounded with areolar tissue, which extends inward among the folds like the stroma of one of the glandular organs. The cells and fibres of the suture itself remained unchanged. During the succeeding weeks the inflammatory reaction subsides and the œdema disappears. The suture shrinks until it appears like a glistening white tendinous cord. In longitudinal section it looks like normal fascia, and in cross-section it closely resembles tendon. The folds are now so closely pressed together that they can be scarcely recognized, and the processes of areolar tissue which extend among the folds have become so thinned out as to resemble the normal connective-tissue stroma of a tendon. Surrounding the whole is an areolar film from which the stroma with its blood-vessels passes into the cord. Specimens recovered after the lapse of many months appear to have undergone no further change. No stretching or contracture occurs, and the strength of the suture is approximately the same as at the time of operation (*Figs.* 217–225).

FIG. 219.—Drawing of living suture of fascia, recovered two years after insertion in rabbit's back. It does not appear to have been changed by the lapse of time.

The effectiveness of strips of fascia as sutures is fully demonstrated by the specimens. It appears to be necessary only to anchor the suture securely at its two extremities and to make sure of getting a good grip of the edges of the gap in the fascia to hold them permanently in their original position. The superiority of the suture over absorbable material is self-evident, and over linen, silk, or silver wire it has the advantage that it has no tendency to cut out or to set up irritation of any kind. Unlike these materials, it heals to the edges of the defect at the points where the needle passes through them.

The idea of using strips of the fibrous tissues as living sutures appears to have solved the uncertainty which attended the use of patch-transplants.

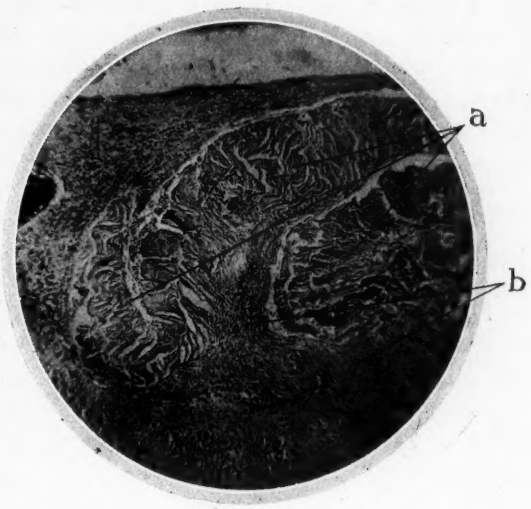


FIG. 220.—Cross-section of portion of fascial suture after three weeks. (Low power.) *a*, Folds of fascia; *b*, New connective tissue surrounding the whole suture and extending into the spaces between the fascial folds.

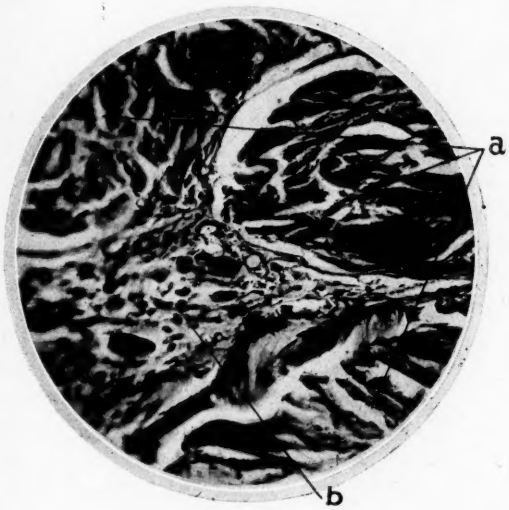


FIG. 221. — High-power photograph of same section as shown in *Fig.* 220. The cells of the fascia are stained well, the outline of each fold is distinct, and there is no invasion of the fascia itself by new tissue. *a*, Folds of fascia; *b*, New tissue between the folds.

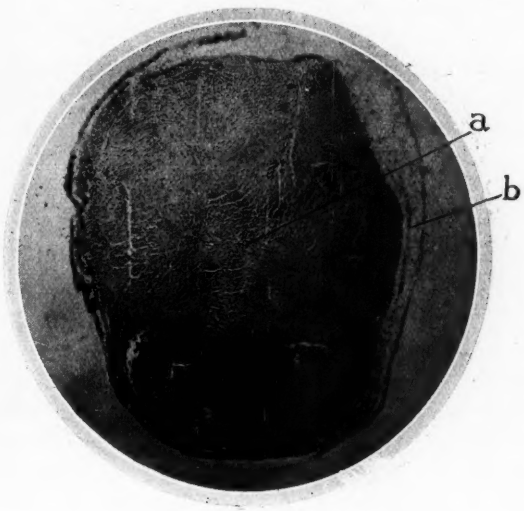


FIG. 222.—Cross-section of fascial suture after six weeks. (Low power.) The suture is now a rounded cord. The separate folds can no longer be distinguished, and the new tissue between them is represented merely by narrow trabeculæ of connective tissue. *a*, Rounded cord of fascial suture; *b*, Vascular areolar tissue.

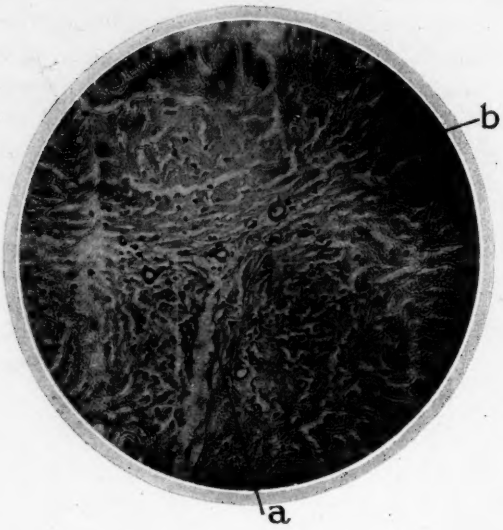


FIG. 223.—High-power photograph of same section as shown in *Fig.* 222. *a*, Connective tissue between the folds of fascia; *b*, Fascia, which is obviously alive and resembles normal fascia in every way.

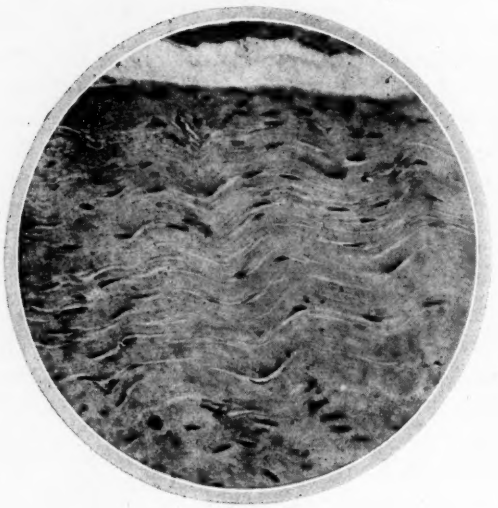


FIG. 224.—Longitudinal section of fascial suture after six weeks, showing the persistence of the normal parallel arrangement of the fibres. (High power.)

FIG. 225.—Cross-section of fascial suture after two years. (Low power.) It is still in the form of a rounded cord, and shows no appreciable change from the six-weeks' suture depicted in *Fig.* 222.

In the latter the whole success of the operation depends on the character of the healing of the transplant to the tissues to which it is sewn, whereas, in the former, this doubtful factor is completely removed and the whole test of the effectiveness of the operation falls on the transplant itself. If this lives and remains unchanged, and experimental evidence seems to demonstrate this, there is no reason why a great variety of anatomical defects should not yield to fibrous tissue transplantation.

CLINICAL APPLICATIONS.

Since the commencement of our experiments, we have had ample opportunity, both in military and civilian practice, to test clinically the principles outlined. For purposes of description the cases may be grouped as follows: (1) *Injuries to Tendons*; (2) *Injuries to Ligaments*; (3) *Certain Ununited Fractures*; (4) *Paralytic Deformities*; (5) *Facial Paralysis*; (6) *Ptosis of Viscera*; (7) *Hernia.*

1. INJURIES TO TENDONS.

Of these we have had a great variety, usually wounds of tendons which have failed to unite and in which contracture of the muscle has made it impossible to bring the ends of the tendon into apposition. The cases include several in which transverse wounds on the palmar aspect of the wrist have divided all the structures from the skin to the bone. The majority, however, have been cases of ununited wounds of one or more important tendons. How these cases shall be dealt with depends on the amount of strain the tendon is normally called upon to withstand. To fill the gap with a transplant of tendon or fascia placed in neat end-to-end apposition seems to us to be too uncertain a method to merit consideration. Failures or partial failures owing to stretching of the scar are very frequent. The strength of the union can be increased by bevelling the ends where they are in contact and thus enlarging the area of the raw surfaces which are opposed to one another. Since the idea of living sutures suggested itself, however, we have employed these on nearly all occasions. An example will illustrate the manner of their use.

A butcher was admitted to hospital with a marked disability of the hand which had resulted from a knife wound, six months previously, through the thick of the thumb. The flexor longus pollicis had been severed, and the cut ends were widely separated. The ends of the tendon were exposed by two incisions, one along the inner border of the short muscles of the thumb, and another above the wrist. They were drawn together as closely as possible, but a gap of three-quarters of an inch still persisted. A thin strip was then cut from the tendon of the palmaris longus, about four inches in length and one-sixteenth of an inch thick, and threaded on a needle. It was tied into the needle with fine silk, and a catgut ligature fastened around its terminal end to prevent fraying. Without freshening the ends of the severed tendon in any way they were woven together with the living suture, much as one splices a rope, or, better, laces a leather belt. The suture was first anchored in the end of the tendon nearest the muscle by passing the needle into the side and out of the end of the tendon and then through the tail of the suture. In

this way a firm slip-knot was made which could not cut out owing to the scar-tissue on the end of the severed tendon. The suture was then carried backward and forward across the gap, making sure to get a good grip of the ends of the tendon, until the suture was used up. It was finally anchored by splitting the tail into two strands and tying them together in a triple knot around one of the loops of the suture. The knot was secured against untying by transfixing and tying it with a catgut ligature. The patient commenced active movements of the thumb in three weeks, and returned to his work in two months. It is now four years since the operation, and he has perfect function in the thumb.

The advantages which we see in the method are several. In the first place, it is simple and easy of execution. In the second place, it allows the cut ends of the tendon to be drawn together under strong tension, and thus restores the muscle as closely as possible to its normal length; this is of importance if the normal power and range of motion are to be restored. And lastly, it eliminates the element of chance which attends healing by scar-tissue, and places the whole responsibility for union upon the transplant itself and on the manner in which it is woven into the ends of the tendon.

Injuries to Tendons which normally are Subjected to great Strain.—

Ligamentum Patellæ.—While the method described above has proved perfectly satisfactory in bridging gaps in ordinary tendons such as those of the forearm, we have hesitated to trust to it in wounds of such powerful tendons as the ligamentum patellæ. Of this latter condition we have had four cases; one in which the tendon had been ruptured at its middle, about a year previously, by a fall on an iron radiator; one in which the tendon had been evulsed from its insertion and failed to unite to the bone after prolonged fixation; one in which the tendon had not united firmly after suture with catgut following a transverse operative incision into the knee-joint; and one in which the tendon had been forcibly torn from the patella, carrying with it a small flake of the bone. Each of the cases came into our hands a year or more after the accident, and showed such a degree of disability through absence of power to extend the knee that operative treatment was required. In all of the patients the patella was held high above the condyles of the femur and there seemed to be little prospect of drawing it down to its normal position. We were consequently faced with the necessity of bridging a gap with a transplant and at the same time making the repair so strong that it would withstand tremendous degrees of strain. After some consideration an operation was devised which has proved satisfactory in all four cases and can be employed equally well in all types of the injury.

Through an **S**-shaped incision on the front of the knee-joint, the patella, the remains of the injured tendon, and the tubercle of the tibia are freely exposed. The pieces of the tendon are split longitudinally in the middle line, from the patella to the tubercle. With a $\frac{5}{16}$-in. drill two holes are bored through the patella from the upper to the lower border. At the upper border these drill holes are about one inch apart, and at the lower about half an inch. At the lower border, therefore, when the drill has passed through the bone, it enters the remains of the ligamentum patellæ. It is pushed steadily onward until its point appears in the median incision in the old tendon. A $\frac{3}{8}$-in. drill is now applied to the tubercle of the tibia, and a deep hole is bored obliquely

downward into the bone. A $\frac{3}{16}$-in. drill is then applied to points on the internal and external surfaces of the tibia about an inch below the hole in the tubercle, and holes are bored which incline obliquely upward to meet the large hole in the depths of the bone. At this stage the patient is turned on his side and the tendo Achillis of the same leg exposed. A segment of this tendon, composed of half its thickness and about seven inches long, is removed and

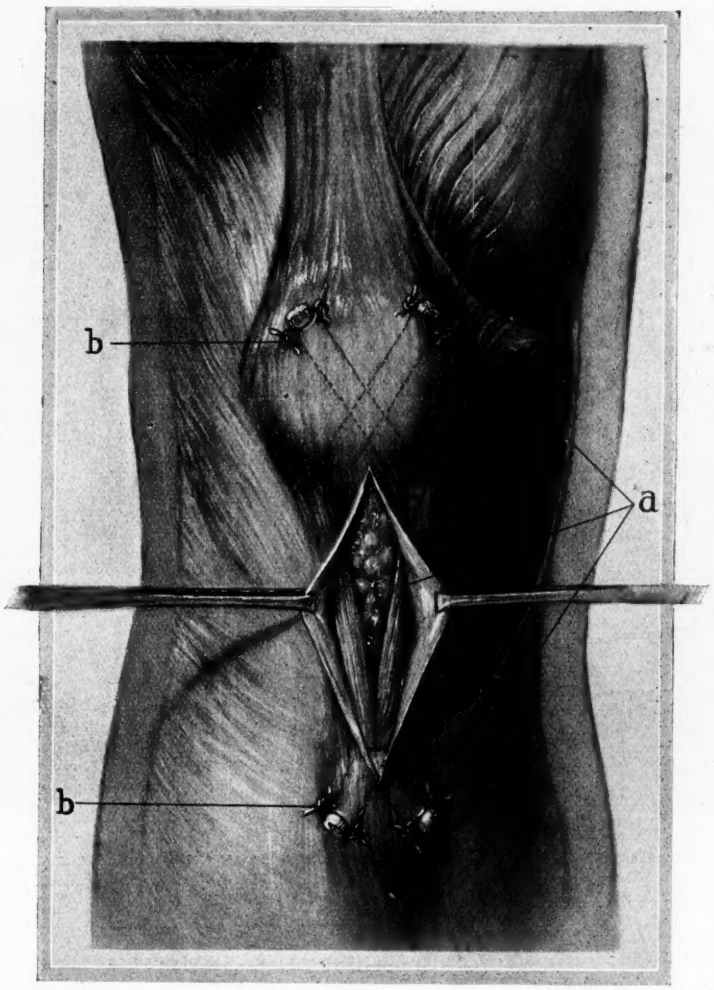


FIG. 226.—Drawing of operation for the repair of ruptured ligamentum patellæ. *a*, Segment of tendo Achillis drawn through holes in patella and tibia. *b*, Kangaroo sutures which fasten the transplant in place until firm healing occurs.

split into two equal parts. All areolar tissue is carefully scraped away, and —from above downward—the transplants are threaded through the holes in the patella into the large hole in the tubercle of the tibia and out through the small holes in its internal and external surfaces. The patella is then dragged downward with sharp-hooked retractors as far as it can be induced to come, and the new tendons are pulled taut and sutured together and to the

neighbouring periosteum with kangaroo tendon. This suturing must be done thoroughly, as upon it depends the anchoring of the patella until the new tendons become firmly healed to the bone. As the total cross-section of the transplanted tendon is considerably less than that of a normal ligamentum patellæ, we have thought it wise to give additional strength to the repair by bridging the gap in the old tendon by a living suture made from the tendon of the plantaris longus, or, if the rupture has taken place at the attachment to the tibia or patella, by weaving the living suture into the end of the tendon and through the holes in the bone. The old and new tendons are finally sewn

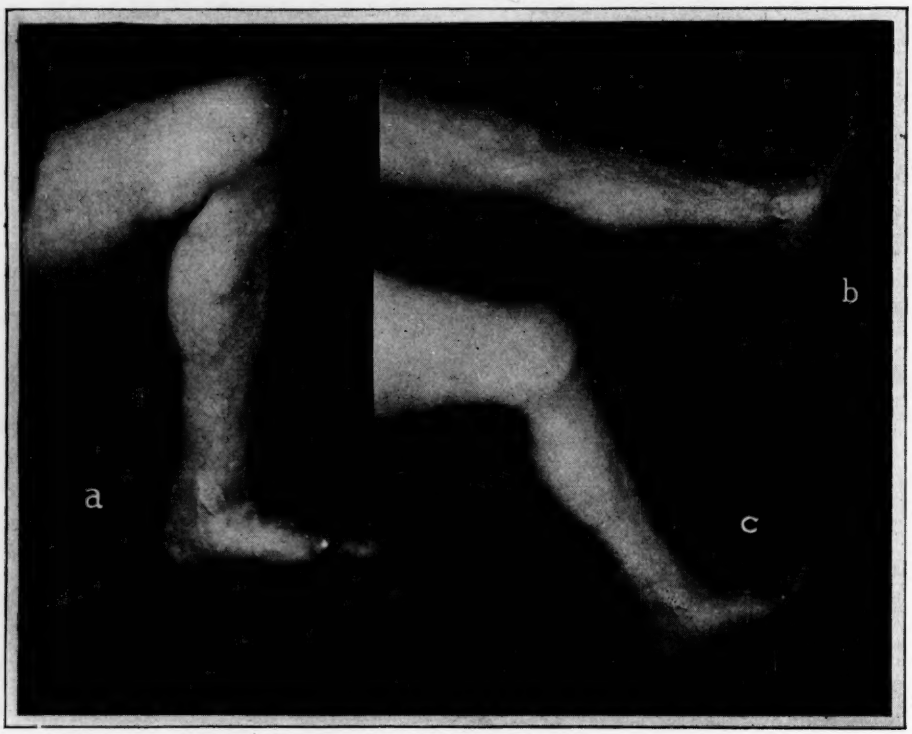


FIG. 227.—Photographs (*a*, *b*, *c*) of patient operated upon five years ago for rupture of the ligamentum patellæ. They show the range of voluntary movement to be normal, and give some idea of the power in the extensors.

together into a compact mass with catgut. (*Fig.* 226.) The limb is encased in plaster-of-Paris for about eight weeks, after which active movements are begun.

This operation has so far proved entirely satisfactory. All four patients are workmen who are engaged in laborious occupations. The first patient, a bricklayer, was operated on five years ago. The others were operated on four, two, and one year ago respectively. They have no disabilities whatever. (*Fig.* 227.)

Rupture of the Quadriceps Tendon.—There have been two cases of rupture of the quadriceps tendon at its attachment to the patella, which had at first seemed to be healed firmly, but in which the scar ultimately became stretched. These were treated by suturing the end of the tendon to the patella with several

mattress sutures of fascia lata. They were woven securely into the tendon and then passed through vertical holes in the patella. The ends were woven into each other and sutured with catgut. No preliminary dissection of the end of the quadriceps was done for fear that it might lead to cutting out of the sutures. These patients have been walking for about a year and have no disability.

Ununited Wounds of the Tendo Achillis.—This not very uncommon condition lends itself well to treatment with living sutures. The type of operation required will depend on the nature of the injury, but the presence of the plantaris tendon in the neighbourhood makes the problem easy. This tendon makes an ideal suture, as it is so slender that it may be used in place of catgut to sew together the freshened ends of the tendo Achillis if these can be overlapped, and it is so strong that it may be used to bridge a gap when the ends of the severed tendon cannot be brought together.

Our first patient was a young man who had received a wound in the middle of the tendo Achillis some months previously, and in whom the scar had become so stretched that he had no power to plantar-flex the foot. The operation consisted of a dissection of the ends of the tendon, with removal of the scar, so that they could be overlapped. They were then sewn solidly together with sutures made by splitting the plantaris tendon into two strands. The result was excellent.

We have at present under observation a patient who two years ago ruptured his tendo Achillis at its attachment to the os calcis. He was treated by prolonged fixation of the foot in the equinus position, but the subsequent strain of walking separated the tendon from the bone or so elongated the scar that the plantar-flexor power of the foot was lost. We propose to repair the defect by splitting the tendo Achillis as in a tendon-lengthening operation and using half of it as a free transplant. This will be passed through a hole in the os calcis and anchored there with catgut. The two halves of the tendon will then be sewn together with a 3-in. to 3½-in. overlap. If it seems advisable the plantaris tendon will be used as a living suture to reinforce the repair.

Up to the present all the cases of injuries of tendons that have been treated with transplants of tendon or fascia had been under treatment for several months before operation. We have not had occasion to treat a case at the time of the accident. We are so convinced, however, that the healing of such structures as the ligamentum patellæ and the tendon of the quadriceps is unlikely to prove sufficiently strong to stand the strain of normal activity, that, when the occasion arises, we shall attempt to repair the damage immediately by some form of fascial transplant or by living suture.

2. INJURIES TO LIGAMENTS.

Habitual Dislocation of Patella.—It is rare that injuries to ligaments require operative treatment. Yet in ligaments, as in tendons, firm healing does not always take place. As a result, dislocations are likely to recur and become exceedingly troublesome. Our attention was first drawn to the condition in 1917 when a soldier was admitted to military hospital with a lateral dislocation of the patella. His history was that a year previously the

patella had been dislocated during a collapse of a dug-out. The treatment had consisted of immobilization of the limb in full extension for several weeks. Two months later the displacement recurred during sudden bending of the knee. A plication of the inner portion of the capsule with catgut was then performed, but within four months the dislocation had recurred again. After this last recurrence it was found that the patella would slip outward over the condyle as soon as the pressure of the hand was removed from it. In view of this, further treatment was abandoned. When he came under our observation the patella was lying on the lateral aspect of the lower end of the femur and could not be dislodged from this position. The man walked only with crutches, and complained of great pain whenever the joint was moved. The cause of the recurrence of the dislocation was the marked degree of knock-knee which was present.

The following operation was performed: The patella was freed of adhesions by dissection and forcibly lifted back into the intercondylar notch. Through a vertical incision on the inner side of the joint the inner border of the patella and the internal condyle were exposed. A transverse hole was then drilled through the widest portion of the patella with a $\frac{1}{4}$-in. drill, and two other holes, separated by about an inch, were bored in the internal condyle so that they met in the depths of the bone. A segment of the tendo Achillis composed of half its thickness and about seven inches long was then removed and passed through the hole in the patella, into one of the holes in the condyle, and out of the other. The patella was drawn as far inward with a hooked retractor as it would come, and the new ligament was drawn taut and anchored to the patella and the condyle with kangaroo sutures. The wounds were closed and the limb encased in plaster-of-Paris, which was moulded against the outer side of the patella to prevent recurrence of the displacement if the sutures should loosen. Massage and movements were commenced in about seven weeks, and after three months the patient was discharged cured. He was examined a few months ago, six years after his operation, and reported that ever since he was discharged from hospital he has been at work without disability as a motor mechanic. During flexion and extension of the knee the new ligament can be felt and seen standing out like a whip-cord between the patella and the condyle. (*Fig.* 228.)

Habitual dislocation of the patella is much more common than we had supposed. Since the operation just described we have seen seven cases, all occurring in girls and young women, without any predisposing cause other than relaxed ligaments. It is an exceedingly annoying condition, as the displacement is liable to occur most unexpectedly, and always produces great pain and sometimes serious falls. Many operations have been designed to overcome it, but few have been completely satisfactory.

One method in particular deserves criticism, namely plication of the capsule. When one remembers the nature of the healing that occurs in wounds of the fibrous tissues, the futility of pleating an uninjured ligament, such as the capsule of a joint, with catgut sutures, must be apparent. To illustrate this point we did a few experiments in which the fascia of the back in rabbits was plicated with catgut and various other suture materials. In some the areolar covering was left undisturbed, but in others it was carefully

scraped away and the fascia scarified. Invariably the folds disappeared after a few weeks and nothing was left to indicate that any operation had been performed. Plication of the fascia with a living suture, on the other hand, is permanent, and suggests at once that if one desires to plicate the capsule of a joint, a suture of tendon or fascia lata should be employed.

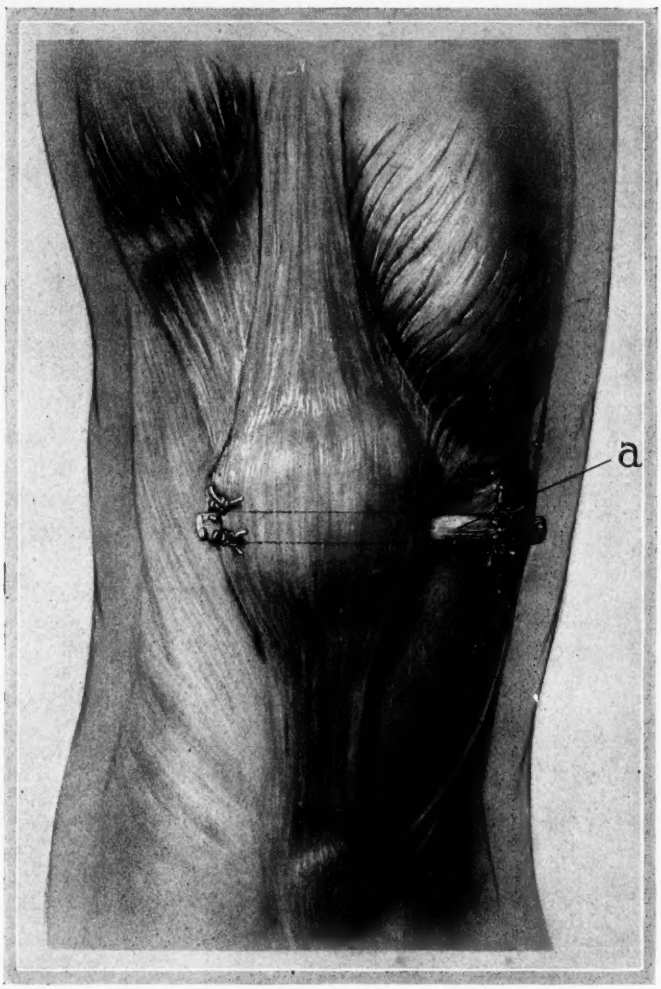


FIG. 228.—Drawing of operation for recurring lateral dislocation of the patella in which great force is required to prevent the displacement. *a*, Segment of tendo Achillis passed through holes in the patella and internal condyle and fastened in place with kangaroo sutures.

For habitual dislocation of the patella, however, we have not trusted to plication of the capsule, as it is such an easy matter to tether the patella to the condyle without disturbing the ligament. The operation resembles that performed on the soldier described above, except that fascia lata is substituted for the tendo Achillis. Through two short incisions, one on either side of the patella, two holes are drilled transversely through the bone. Through another short incision over the internal condyle two holes are drilled into the femur,

which meet in the depths of the bone. A strip of fascia lata, half to three quarters of an inch in width and ten inches long, is obtained from the lateral aspect of the thigh and firmly ligated at each extremity with strong silk. With the assistance of the silk the strip of fascia is drawn from without inward through the holes in the patella so as to form a loop along its outer border. A pair of artery clamps is then passed subcutaneously from the incision over

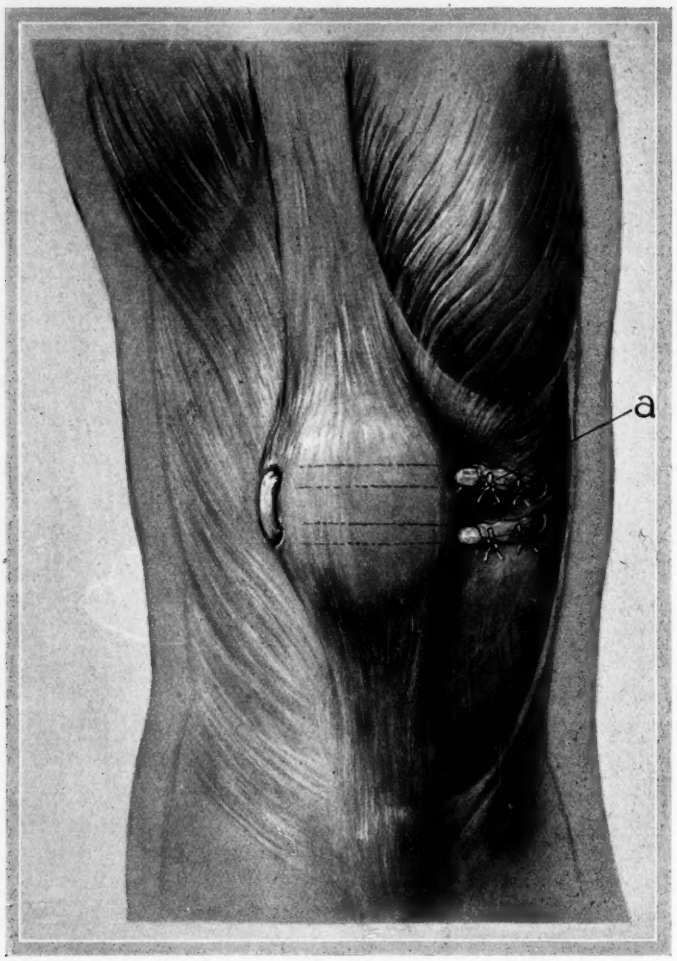


FIG. 229.—Drawing of operation for habitual dislocation of the patella. *a*, Strand of fascia lata, half an inch wide, passed through holes in the patella and internal condyle and fastened with catgut.

the condyle to the incision on the inner side of the patella, and the ends of the fascia are drawn through the subcutaneous tunnel. Again utilizing the silk, the ends of the fascia are drawn through the holes in the internal condyle and pulled sufficiently taut to hold the patella firmly inward. The overlapped portions of the fascia are then freed of areolar tissue and woven through one another once or twice and sutured together with catgut. The silk ligatures are finally removed and the wounds closed. A plaster bandage

is applied from the toes to the upper portion of the thigh with the knee in full extension. (*Fig.* 229.)

The subsequent history of these seven patients has been satisfactory. Movements of the knee were commenced after six weeks, and within a few weeks more the function of the joint was normal. In none of the cases has there been a recurrence of the dislocation.

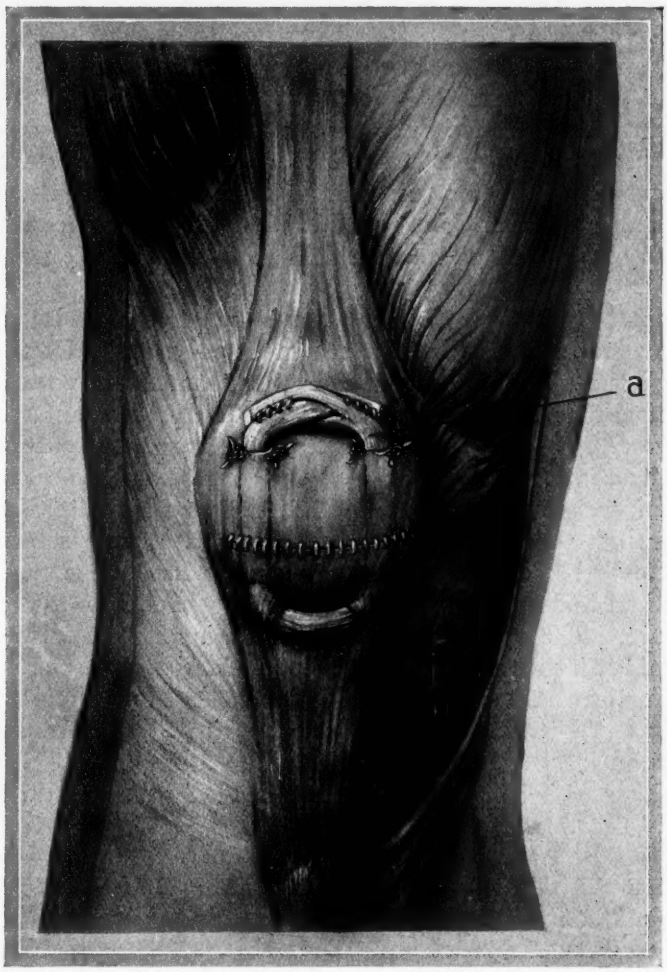


FIG. 230.—Drawing of operation for repair of ununited fracture of patella in which one of the fragments is a mere flake of bone. *a*, Heavy suture of fascia lata passed vertically through the patella and transversely through the ligamentum patellæ.

Recurring Dislocation of the Shoulder.—The observation that fibrous structures such as the capsules of joints may be plicated successfully, if narrow sutures of fascia lata are used, suggests at once that recurring dislocation of the shoulder might be effectively treated by this means. Unfortunately the only opportunity we have had to try the method occurred at the very commencement of our experiments with living sutures, and our operation was very imperfectly performed. Recurrence of the dislocation was prompt. We

are still of the opinion, however, that the method might be useful in cases which are definitely the result of relaxation of the capsule of the joint.

3. UNUNITED FRACTURE OF THE PATELLA.

The success of the operations on the ligamentum patellæ already referred to led us to apply a similar method to cases of ununited fracture of the patella in which the bones could not be brought together, or in which the fracture had occurred so close to the upper or lower border of the bone that it seemed unlikely that an operation designed solely to induce union in the fracture would provide sufficient strength to withstand the normal strain. In the former the fragments were drawn as closely together as they would come, and were held in this position by a heavy loop of fascia lata passed through drill holes. The ends of the loop were freed of areolar tissue and woven through one another and sutured with catgut. By this means the continuity of the quadriceps was established and a considerable portion of the normal extensor power restored.

In the ununited fractures close to the upper or lower border of the patella, the drill holes were made in the large fragment only, and a loop of fascia was drawn through the quadriceps tendon or the ligamentum patellæ through a transverse tunnel made with a narrow knife. The presence of the small flake of bone on the end of the tendon prevented the loop from cutting out. One case will illustrate the effectiveness of this operation. The patient was a tall young man, weighing 250 lb., who had fractured his patella some months previously through the lower tip of the bone, with wide separation of the fragments. He had been treated by placing the limb on a posterior splint, but no union had taken place. He was seriously handicapped by inability to extend the knee. The operation consisted of bringing the freshened surfaces of the fragments together and inserting a loop of fascia lata, one inch in width, through two vertical holes in the upper fragment and transversely through the ligamentum patellæ just below the lower fragment. The transverse rent in the lateral expansion of the quadriceps tendon and the capsule of the knee was closed with a living suture of fascia threaded on a needle. A complete cure resulted. (*Fig.* 230.)

4. INFANTILE PARALYSIS OF THE SHOULDER IN SMALL CHILDREN.

In infantile paralysis involving the shoulder girdle, but sparing the trapezius, no better operation has been devised than arthrodesis of the shoulder-joint. In small children, however, it is impossible to ankylose the joint owing to the relatively small amount of bone in the articulating surfaces. In several such children we have materially improved their condition by weaving the acromion process to the greater tuberosity of the humerus with strips of fascia lata. These strips were passed through holes in the two bones and drawn sufficiently tight to hold the humerus in moderate abduction. When firm healing had occurred the patients were able to abduct and raise the humerus by means of the trapezius. The method is limited in its application, however, as there is no great reason why these patients should not wait till the bones entering into the shoulder-joint have developed sufficiently to allow a successful arthrodesis.

5. FACIAL DEFORMITIES.

In the field of plastic surgery, particularly in that of the face, the principle of living sutures may prove of value. It has been used with excellent results by our *confrère*, Dr. W. W. Wright, in the treatment of congenital ptosis of the eyelids. In this operation two strands of fascia lata about one-sixteenth of an inch wide are threaded on curved needles and tied in as already described. A needle is attached to each end of the suture. A horn plate is placed beneath the eyelid and two small puncture wounds, as shown in *Fig.* 231, are made through the skin at **A** and **C** with a sharp-pointed tenotome about 6 mm. above the margin of the lid. A transverse incision **B D**, 1 cm. long, is made just above the brow. One needle is now entered at **A** and carried upward subcutaneously to emerge at the nasal extremity of the incision **B D**. The other needle is then entered at **A**, passed under the skin, brought out at **C**, re-entered through the same hole, and brought out above at the temporal end of the incision **B D**. The second suture is then inserted in a similar manner in the outer half of the lid. The ends of the sutures are now drawn tightly enough to

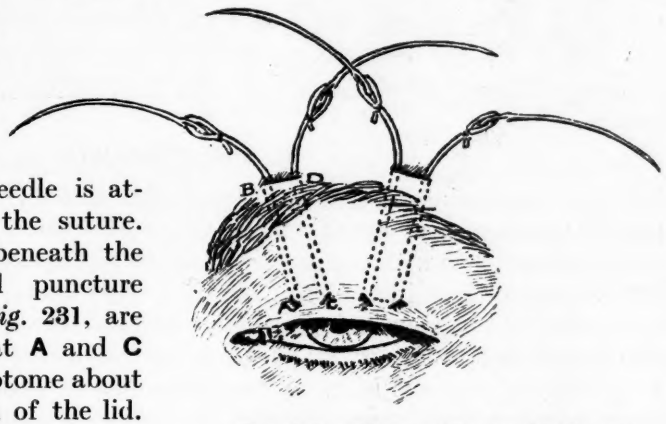


FIG. 231.—Diagram of operation for congenital ptosis of eyelid in which the lid is permanently suspended from the occipito-frontalis with narrow sutures of fascia lata.

FIG. 232.—Photographs of patient on whom the operation for congenital ptosis of the left eyelid had been performed 3½ years previously.

raise the lid to the desired height, and are then tied in a knot which, after transfixion with fine catgut, is dropped back into the transverse incision and buried under the skin.

The accompanying photographs illustrate the result of this operation after the lapse of 3½ years (*Fig.* 232). No change in the suspension of the eyelid has occurred during that time, and the boy has excellent control of it through the action of the occipito-frontalis. Twelve patients have been operated upon by this method at the Hospital for Sick Children, and all with satisfactory results.

6. VISCEROPTOSIS.

The uncertainty which attends operations for the fixation of viscera may possibly be removed by the substitution of strips of fascia for catgut. Our clinical experience with the method has not been great, but as far as it has gone it has been encouraging. Two cases of floating kidney which had been suffering from crises of abdominal pain were treated by sewing the kidney to the abdominal wall with sutures of fascia lata. In each case the symptoms have been relieved and the kidneys have remained in place. The first patient was operated upon three years ago, and the kidney was fixed by the simple weaving of a fascial suture through the capsule and into the lumbar aponeurosis. In the second case, operated on eighteen months ago, two separate sutures were used, one of which was passed through the upper pole of the kidney and around the last rib, and the other inserted as a large mattress stitch under the capsule and fastened into the abdominal aponeurosis. When the occasion arises again we shall use sutures obtained from the fascia of the back and so avoid the necessity for an incision in the thigh.

7. HERNIA.

A thoughtful analysis of the results of the operative treatment of hernia in adults will convince the most sanguine that there is much room for improvement. The percentage of recurrences varies greatly with the experience and skill of the operator, but, even in the hands of the most skilful, recurrences after the closure of large ventral hernias, direct inguinal hernias, and long-standing oblique inguinal hernias are very frequent.

It was in the treatment of these conditions that the transplantation of patches of fascia lata first came into prominence, and for a time it seemed that the difficulties in the way of a cure had been successfully solved. Before long, however, recurrences again began to appear, and ultimately became so frequent that nowadays the method has very few advocates. In explanation of these failures one often hears it said that the transplant has been absorbed. Our researches, however, have led us to the opinion that in the majority of instances this explanation is incorrect, and that the blame for the recurrence of the hernia must be laid to the character of the healing between the transplant and the surrounding tissues. Our experiments on animals resembled very closely the usual method of filling a defect in the abdominal wall with a patch-transplant, or of re-enforcing the line of suture after closure of the opening. The same care in overlapping the edges of the transplant and the surrounding tissues was observed. But the experiments indicated that, although the patch

of fascia continued to live almost unchanged, it healed to the edges of the defect by the flimsiest kind of tissue, and if the line of contact were under strain the edges almost invariably drew apart. This separation of the edges is even more likely to occur in operations on hernia, as operators rarely take the precaution to remove the areolar membranes from the surface of the transplant and the edges of the defect. The adhesion, therefore, can have only the strength of these areolar membranes, and can be of no importance whatever in preventing the separation of the hernial ring.

If one is tempted to use a patch-transplant to assist in the closure of a ventral hernia. one should observe the precaution of scarifying the surfaces of the transplant and of the surrounding tissues which are placed in contact, in order that firm adhesion may take place. In spite of such precautions, however, the surgeon must place his whole trust in the character of the healing which occurs, the strength of which is very uncertain. The light scar-tissue which develops between overlapped aponeurotic surfaces is not equal to the strain which must be resisted in large ventral hernias. There is no probability, therefore, that the use of patches of fascia lata, sewn in with absorbable sutures, will ever be revived again.

Ventral Hernia.—Ventral hernia is an ideal condition for closure with living sutures. By their use the uncertainty which attends healing by scar-tissue is totally eliminated and the whole responsibility for a cure placed upon the sutures themselves. There is practically no limit to the number of sutures that may be inserted, so that it becomes simply a matter of the judgement of the surgeon as to how many layers of sutures are necessary to restore the abdominal wall to its normal strength. The chief precautions which must be observed are to see that the sutures are woven securely into the tissues surrounding the opening, and that these tissues, wherever possible, include aponeurosis. It is preferable to make no preliminary dissection of the edges of the hernial ring into their various layers, as the grip of the sutures is most secure when they are undisturbed. If the edges of the ring can be drawn together without too great tension, so much the better; but if they cannot, the gap which is left may be closed by weaving the sutures across the opening as in the darning of a sock.

From our experience with living sutures a few points in technique have been evolved which are useful. Much time can be saved by having a second operator to secure and prepare the sutures. A few minutes before they are required he makes a long incision on the lateral aspect of the thigh and exposes the fascia lata. The fat and areolar tissues are carefully removed with the blade of a scalpel over the whole area from which the sutures are to be taken. A small longitudinal incision is then made through the fascia, and with a pair of blunt-pointed scissors it is ripped to the required length. This will vary from nine to twelve inches according to the length of the thigh. A second incision in the fascia is made a quarter of an inch lateral to the first, and one end of the suture so prepared is cut free and trimmed to a point. This end of the suture is passed through the eye of a large curved needle, and tied securely after transfixion with fine silk. The needles are very thick, and have an eye which is large enough to allow the strip of fascia to enter easily. The terminal end of the suture is then cut free, and a fine linen ligature is tied

around it to prevent splitting. The suture is now lifted from its bed and is ready for use. In taking the first stitch the needle is passed through a tough portion of the edge of the gap to be closed and then through the terminal end of the suture. In this way a slip-knot is produced which forms an excellent anchor. The suture is woven strongly into the edges with as many bites as seem necessary, and passed backwards and forwards across the opening until its whole length is used up. Owing to the slippery character of the fascia it will be found useful to anchor the sutures at every second or third stitch by some form of knot. We usually combine a single loop-knot with transfixion. When the first suture has been used up a second may be attached to it in the same way as pieces of tennis gut are fastened together, and the sewing continued. In this way one suture after another may be inserted until the opening is completely closed. The suture is finally ended by splitting its terminal portion into two strands which are tied together about the suture in a triple knot. This knot should be made secure by transfixing it with a catgut ligature which will hold its loops in contact until they become firmly healed together. (*Fig.* 233.)

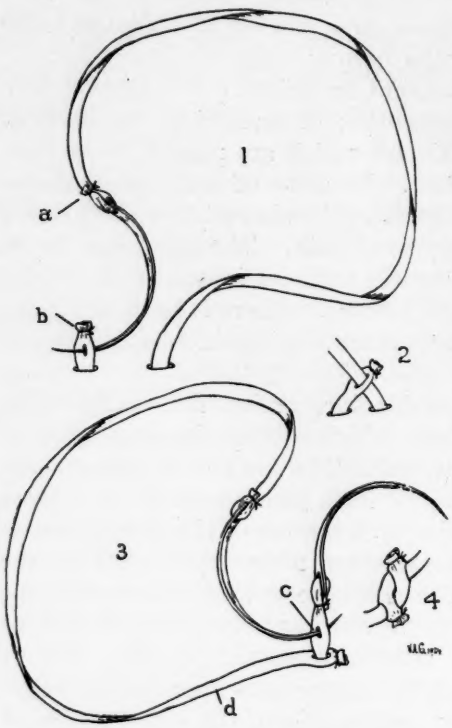


FIG. 233.—Diagrams illustrating points in the technique of using living sutures of fascia.

1, The strip of fascia lata has been tied into a large-eyed needle with fine silk (*a*), and a similar ligature has been tied around the tail of the suture at *b*. The needle has been passed through some strong aponeurotic tissue and then through the tail of the suture to form a slip-knot. 2, The slip-knot drawn taut. 3, Method of joining one suture to another. The suture (*c*) has been used up. The needle of suture *c* is passed through the tail of suture *d*, and the needle of suture *d* is then passed through suture *c*. The needle of suture *c* is cut off, and suture *d* is drawn taut. 4, The jointing of the two sutures completed.

The wound in the thigh has never given us any concern. Where not more than four sutures have been removed, the opening in the fascia can be readily closed with catgut, and there does not appear to be sufficient strain upon it in the ordinary movements of the thigh to cause it to open again. In several instances, however, so much fascia was used that the opening could not be closed, and in these cases no attempt at closure was made. In not a single patient, of the two hundred or more in whom strips of fascia have been removed from the thigh, has there been any complaint of symptoms or any evidence of disability resulting therefrom.

The details of the operation for ventral hernia are simple. The sac is dissected free of the edges of the ring, and removed or pushed back without opening it, as seems best at the time. The peritoneum is separated from the abdominal wall in the immediate neighbourhood of the opening in order

that the sutures may be inserted without puncturing it. As already stated, the edges of the hernial ring are not separated into the various layers of aponeurosis and muscle, as it has been found that by so doing the strength of the grip of the sutures is lessened. After securely anchoring the suture in some aponeurotic structure the opening in the abdominal wall is closed by a through-and-through running stitch. Care is taken that each loop of the suture passes through strong aponeurotic tissue, well back from the edges of the opening, so that all possibility of cutting out is avoided. So secure is

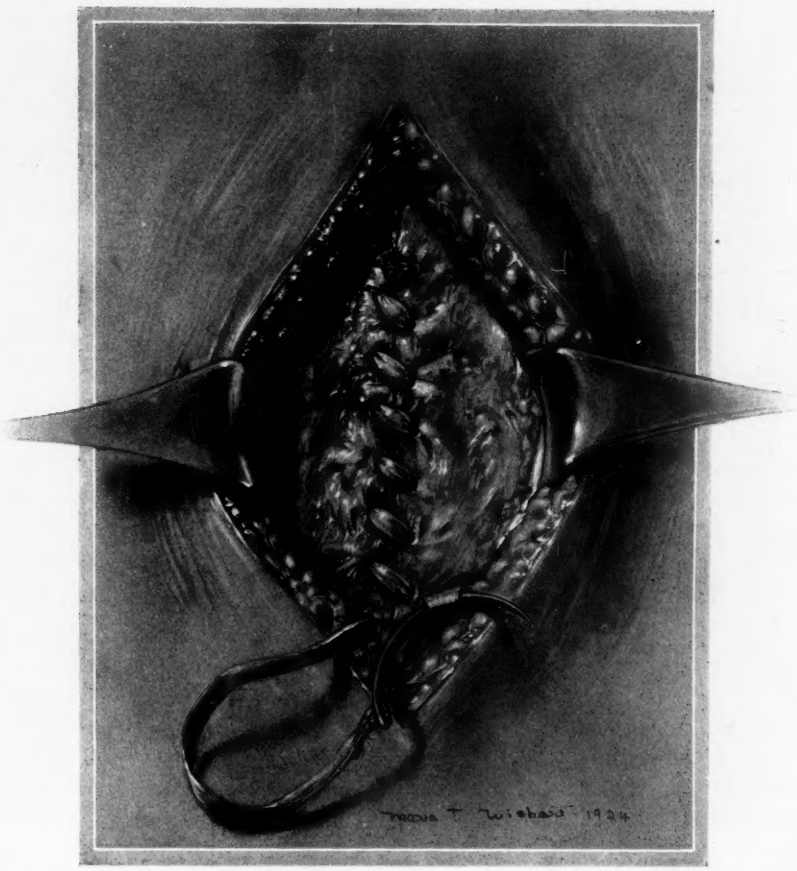


FIG. 234.—Drawing of the repair of ventral hernia with sutures of fascia lata. Insertion of the first row of sutures which brings the edges of the defect together or as nearly together as they will come without great tension.

the closure when performed in this way that in most instances a single row of sutures is sufficient, but when the opening is larger, or the anticipated strain severe, it is well to support the first row of sutures by a second. This is inserted somewhat as in the lacing of a boot. By means of it the strain is distributed widely over the abdominal wall, and the tension on the former defect correspondingly reduced (*Figs.* 234, 235).

In some of our cases the opening in the abdominal wall has been so large that it was impossible to draw the edges together by any form of suture. In

other cases it was possible to draw them together only at the risk of so increasing the intra-abdominal pressure as to endanger the patient's life. In these patients the edges of the opening were simply drawn as closely together as seemed safe, and the space left was completely filled with a meshwork of sutures. The strips of fascia were so interwoven with one another that no chinks were left through which a hernia could occur. When the healing

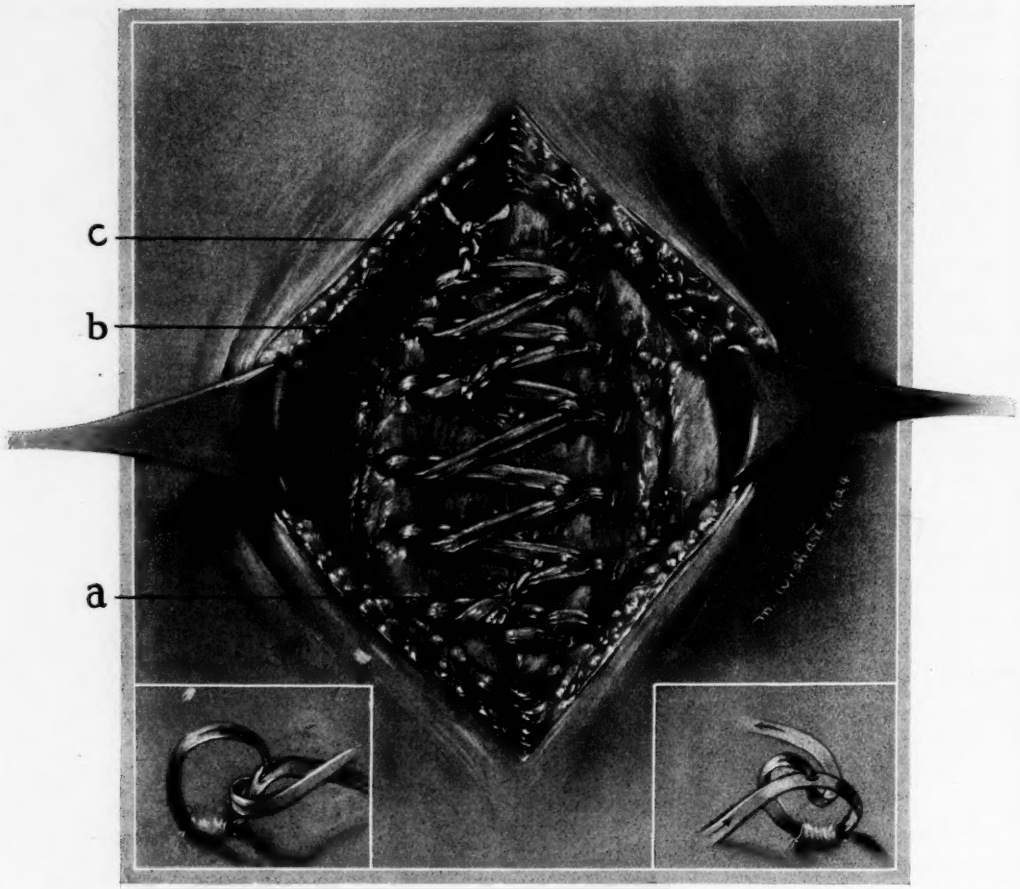


FIG. 235.—Drawing of the repair of ventral hernia. Insertion of second row of sutures. The needle takes deep bites of the aponeurosis at some distance back from the edges of the opening.

a, A join between two sutures; *b*, Lock-stitch inserted to prevent slipping; *c*, Triple knot which terminates the suture. It is transfixed with a ligature of fine silk or catgut.

The inserts in the lower corners show methods of making the lock-stitch.

process is complete the abdominal defect is filled with an aponeurotic structure which is comparable with the linea alba.

During the past five years the sutures of fascia lata have been used on many occasions in closing ventral hernias. Most of the cases had been operated upon previously by other methods, and in all the possibility of a permanent closure was doubtful. In some it seemed certain that operative treatment would be futile. So far all the operations have been successful.

In several in which it was impossible to close the gap completely the strands of fascia and the knots can still be felt distinctly through the skin.

Inguinal Hernia.—Our attention was drawn to the question of recurrence of inguinal hernia by the large numbers of soldiers who have returned to our military hospitals for treatment of hernias which had already been operated upon once and sometimes several times previously. Many of these patients have come under our direct care, and we have taken the opportunity to study the cause of the recurrence and to attempt to find a remedy for it.

The histories of these patients indicated that some of the hernias had been present from childhood and had been operated upon just previous to enlistment, and that some had developed during service and been treated by operations in military hospitals. In the majority of cases the patients had been kept in bed for three weeks after operation, and had been brought up to class A category by several months of graduated physical training. Little criticism could be offered of the after-treatment.

Our findings at operation showed that a few which originally had been oblique hernias had recurred into the cord. In all probability the sac, in these cases, had never been completely removed. The majority, however, had recurred as direct hernias, irrespective of what the condition had been originally. That direct hernias should recur is not at all surprising, as the records of any hospitals in which this subject has been investigated show that recurrence takes place in from 40 to 50 per cent of the cases, but that hernias which were originally oblique should recur as direct hernias appealed to us as wanting explanation. Unfortunately it is impossible to state definitely from an examination of these patients on the operating table just what was the cause of the recurrence. In most cases the external ring was very large, but whether this was the cause or the result of the recurrence it is impossible to say. In many of the men the hernia had been present for a long time before the original operation, and it may be that the posterior wall of the canal had become so weakened by the dragging of the internal ring towards the external that it was unable to resist the increased abdominal pressure coincident with war-time activities. On the other hand, it may be that the weakening of the abdominal wall has resulted from the original operation in which the fascia transversalis may have been injured or the abdominal muscles destroyed by tight sutures. Whatever the cause of the recurrence, the indications are that in operations for inguinal hernia in adults definite precautions must be taken to leave the abdominal wall medial to the internal ring as strong as it normally should be, and if there is any possibility of the posterior wall of the canal being weaker than normal, it must be supported by some form of plastic operation which is more certain than the ordinary methods of suture.

The defects in these methods of suture were very evident in the cases operated upon. In some the internal oblique muscle had been sutured to Poupart's ligament in front of the cord. In the majority, however, the internal oblique and the conjoined tendon had been sewn to Poupart's ligament behind the cord in an attempt to restore the obliquity of the canal. What may be the relative merits of these two methods of suture it is impossible to say, although theoretically, presuming that the structures which are sewn together stay together after the sutures are absorbed, the latter would seem to be the

more rational. Our findings indicate, however, that it is very problematical whether the structures which are sewn to Poupart's ligament really do stay in this position for any length of time. In every recurred hernia operated upon the internal oblique muscle had separated from Poupart's ligament throughout its inner half, and in some there was no evidence whatever that it had been sewn to the ligament. In not one instance, despite the fact that the records showed that the conjoined tendon and the sheath of the rectus had been sewn to Poupart's ligament with kangaroo tendon or catgut, did we find these structures together at the time of the second operation.

These findings have produced a doubt as to whether the sewing of the muscles and conjoined tendon to Poupart's ligament with ordinary sutures is ever a factor in preventing recurrence of the hernia. Certainly the experiments in which plication of the fascia of the rabbits' backs was performed would indicate that the adhesions of such structures is extremely slight. To investigate the subject further a few experiments were performed in which muscles were drawn out of their normal positions and sewn side-to-side with other muscles and with tendons and aponeurosis. In a very short time after the absorption of the sutures the muscle had returned to its former position, leaving no indication that an operation had been done. If, before inserting the sutures, all areolar membranes were removed from the surfaces which were placed in contact, and particularly if these surfaces were scraped and scarified, the amount of adhesion was greater; but if the normal action of the muscle tended to produce definite strain on the line of suture, the scar-tissue soon became stretched and the intention of the operation defeated. These results demonstrate the folly of dragging structures such as the abdominal aponeurosis, the conjoined tendon, and the sheath of the rectus out of their normal positions to suture them to Poupart's ligament in the hope of permanently strengthening the abdominal wall.

Direct Inguinal Hernia.—In the case of direct inguinal hernia the defect in the ordinary Bassini operation has frequently been recognized, and many attempts have been made to improve on this operation by filling the defect in the abdominal wall with muscular or aponeurotic structures which might be able to withstand the strain. Thus, the transplantation of a portion of the rectus muscle to Poupart's ligament, the turning down of flaps of the rectus sheath, and the transplantation of patches of fascia lata have all had their advocates. These operations all have the defect, however, that they depend for their success on the healing together of fibrous or muscular structures, a factor which unfortunately cannot be depended upon. None of them, therefore, has ever become recognized as the established method of procedure.

The structures about the inguinal canal are peculiarly suitable for the use of living sutures. No dependence can be placed on a muscle such as the internal oblique, but in the immediate neighbourhood are the abdominal aponeurosis, the conjoined tendon, the sheath of the rectus, and Poupart's ligament, all strong fibrous structures which will give firm anchorage for the suture. With a sufficient number of strips of fascia lata, therefore, the weak spot in the abdominal wall can be filled up completely without any disturbance of the normal anatomical relations and without any dependence on the uncertain process of healing.

The operation for direct inguinal hernia presents no difficulties. The incision is made so as to allow perfect exposure of the spine of the pubes and the insertion of the conjoined tendon and the rectus sheath. After splitting the external oblique, the upper leaf is reflected until a good view is obtained of the white abdominal aponeurosis. The sac is dealt with in the usual manner, although occasionally we have done nothing with it more than to push it backward out of the way. The first suture of fascia lata, a quarter of an inch wide, is then anchored securely into the rectus sheath close to its attachment to the pubic bone. The needle is now passed behind the spermatic cord to pierce Poupart's ligament at its insertion into the pubic spine. If possible it should be made to pick up the periosteum to make the security of its fixation more certain. When the suture is drawn taut, the weakest spot in the abdominal wall, namely, that which lies behind the external abdominal ring, is filled with a tough aponeurotic tissue which effectively prevents any bulging through the ring. The sewing is continued in an outward direction, drawing the internal oblique muscle to the reflected portion of Poupart's ligament behind the cord, until the position of the internal ring is reached. Here the suture is locked and then carried to the outer side of the ring, where a supporting stitch is inserted. In this way the cord, at the point where it disappears through the abdominal wall, is surrounded by a fibrous ring which will effectively prevent the development of a hernia at this point. By locking each stitch at this stage the possibility of undue constriction of the cord is prevented. The sewing of the internal oblique muscle to Poupart's ligament in this manner is a detail of the operation which in our opinion is of very little value in preventing recurrence of the hernia. It is of value, however, in permanently covering the peritoneum with a thick layer of muscle which will prevent the protrusion of peritoneum through the chinks of the next layer of sutures, which is the important one in the prevention of recurrence. This layer commences as a continuation of the first, at the outer side of the internal ring. The needle takes a solid bite of the abdominal aponeurosis at its point of fusion with the external oblique and is then passed behind the cord to pick up Poupart's ligament. The suture is carried backward and forward across the space, with frequent lock-stitches, until the sheath of the rectus is reached, and this also is woven to Poupart's ligament until the whole space is filled with fascia down to the pubic spine. No attempt is made with the second row of sutures to drag the abdominal aponeurosis and the rectus sheath out of their normal positions. No greater tension is exerted on the sutures than is sufficient to make them lie flat. The whole idea of the operation is to fill the weak spot in the abdominal wall with what may be called a filigree of living aponeurosis, and to depend on the strength of this filigree and on its grip on the surrounding tissues for the cure of the hernia. What one does with the external oblique is of relatively little importance. Usually in direct hernia it is too weak to be of any value to the surgeon. In our earlier operations we closed it down to the external ring with a narrow strip of fascia, but in the last four years we have simply sewn it up with catgut. The time which is spent in preventing a hernia from getting out of the canal is much better spent in preventing it from getting into it. (*Figs.* 236, 237.)

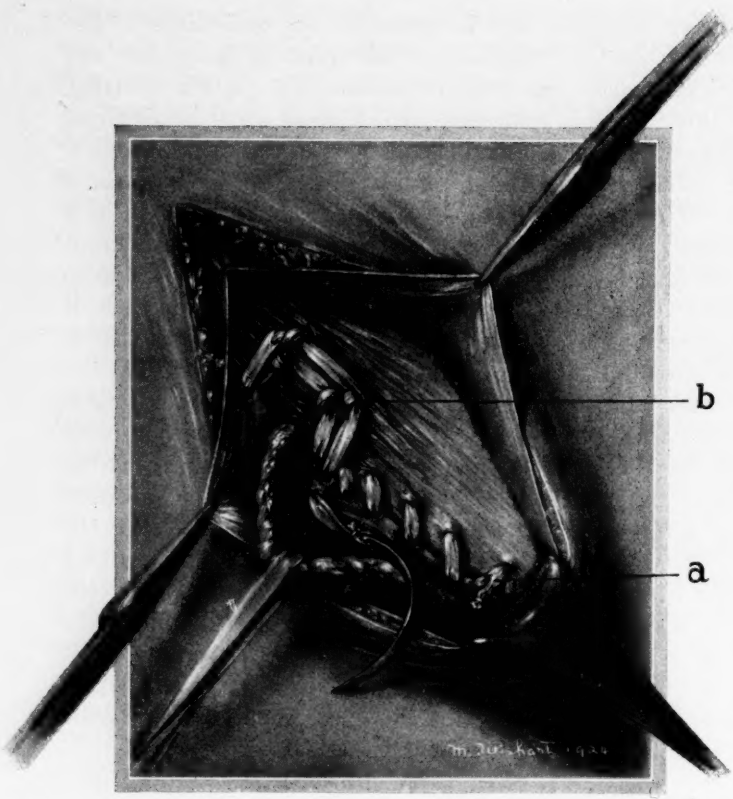


FIG. 236.—Drawing of the repair of an inguinal hernia with sutures of fascia lata. Insertion of the first row of sutures which brings the internal oblique and conjoined tendon into contact with Poupart's ligament, and reinforces the internal ring.

a, Slip-knot anchoring stitch; *b*, Lock-stitch.

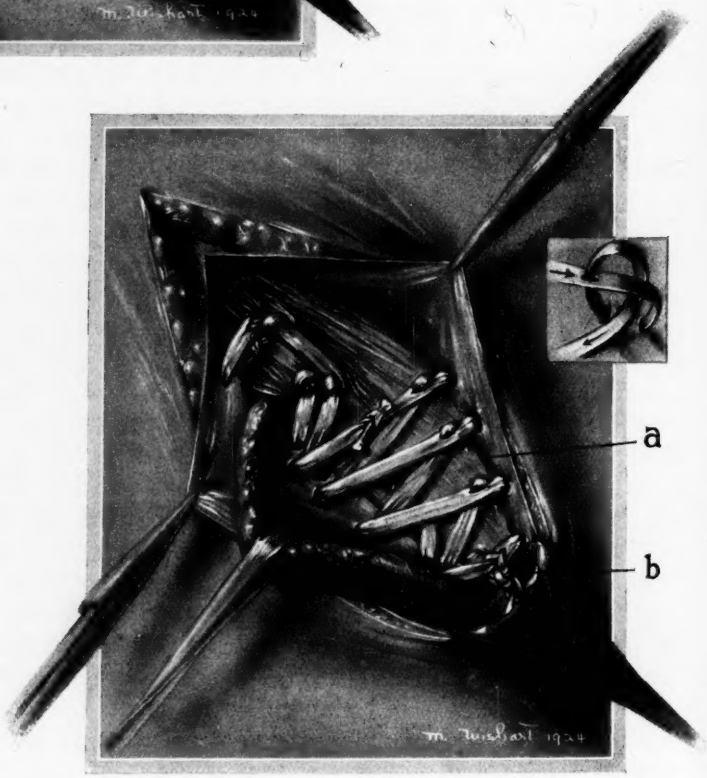


FIG. 237.—Drawing of the repair of an inguinal hernia. Insertion of second row of sutures between the abdominal aponeurosis and Poupart's ligament. These structures are not drawn together, but the interval between them is filled in with a filigree formed by the fascial suture.

a, The line of junction of the aponeuroses of the internal and external oblique muscles in the abdominal aponeurosis; *b*, Termination of suture.

The insert shows the most useful form of lock-stitch.

Oblique Inguinal Hernia.—Oblique inguinal hernia rarely requires special attention to the closure of the abdominal wall. The cure of the hernia, particularly in children and young adults, depends on the complete removal of the sac. In these patients the posterior wall of the canal is normal, and if it is not damaged during the operation, should prevent the development of another hernia. Our researches on the healing of muscle to aponeurosis, and of aponeurosis to aponeurosis, and our observations on the patients in whom hernias have recurred, have led us to think that the internal oblique muscle and the conjoined tendon when sewn to Poupart's ligament rarely stay in the new position. The cures are accomplished in all probability quite irrespective of the attempt to close the supposed abdominal defect.

In many oblique hernias, however, the posterior wall of the canal is not normal. The constant passage of intestine and omentum into the sac gradually changes the narrow entrance of the tunica vaginalis into a wide funnel-shaped opening which materially stretches and weakens the fascia transversalis. The simple removal of the sac in these cases, therefore, leaves the posterior wall of the canal very weak and quite unfit to withstand unusual intra-abdominal pressure. This is true also, in even greater degree, in those cases in which the chronicity of the condition has resulted in the displacement of the internal abdominal ring to a position directly behind the external. These are the cases which call for some form of repair of the abdominal wall.

The operation for oblique hernia is identical with that already described for direct hernia. When it is completed the weak posterior wall of the canal is supported by a permanent meshwork of fascia lata which is sufficient, we believe, to withstand all variations of abdominal strain.

Femoral Hernia.—This form of hernia is a condition which should lend itself well to treatment with sutures of fascia. Unfortunately our experience with the method is limited to one case, so that we are not in a position to draw conclusions. This patient was a woman who had previously been operated upon for femoral hernia but had suffered a recurrence some months later. Our operation consisted of the removal of the sac through an inguinal incision, and the suturing of Poupart's ligament to Cowper's ligament with a suture of fascia lata. The suture was not drawn very tight, as it was not the intention to induce fusion of Poupart's ligament to the pubic bone, but rather to leave the former in its normal position and simply shut off the entrance of the crural canal with fascia. In this way the outer edge of Gimbernat's ligament, which bounds the inner margin of the femoral ring, was advanced in an outward direction by means of the fascia lata, to form the inner boundary of the compartment of the canal occupied by the vein. This operation has so far proved successful.

The treatment of femoral hernias by suture with catgut is by no means certain of success. In all probability the part of the operation which is the most important in accomplishing a cure, in those patients that are cured, is the removal of the sac. The insertion of a catgut suture from Poupart's ligament to the pectineal fascia through a femoral incision, or the suturing of Poupart's to Cowper's ligament through an inguinal incision, can have little effect in producing a permanent closure of the femoral ring. Certainly in the recurred cases which we have seen there has been very little evidence

to show that such suturing had been done. The substitution of fascia for catgut should remove this uncertainty and materially reduce the number of recurrences.

The results of the living suture operation in hernia have been very satisfactory. We now have records of over 100 hernias of all varieties which have been treated by this method over a period of five years, and, up to the present, there have been no recurrences. The majority of the patients had been operated upon previously by other methods, and many had been operated upon several times. The most gratifying results were obtained in the recurred direct hernias, which have hitherto presented a baffling surgical problem. We have no doubt that recurrences among these cases will occasionally appear, for defects in the anchoring of the sutures will sometimes be unavoidable; but if care is exercised in choosing only strong aponeurotic structures for the passage of the suture, and in anchoring it securely at its beginning and end, recurrences will undoubtedly be rare. Even suppuration is not an irreparable disaster, as three of our cases became mildly infected, but without extrusion of the suture or injurious effect on the ultimate result of the operation.

The method is recommended in the following conditions: (1) Direct inguinal hernia; (2) Oblique inguinal hernia in patients at or beyond middle age, particularly when the canal has lost its obliquity and when the abdomen is becoming pendulous; (3) All forms of recurred hernia; (4) All ventral hernias in which there is any doubt in the surgeon's mind as to the permanence of closure by the ordinary methods; (5) Ventral hernia in which closure can be obtained only with disquieting increase of intra-abdominal pressure—in these cases the edges of the hernial ring may be left apart and the space filled with a meshwork of fascial sutures.

CONCLUSIONS.

1. In the repair of certain anatomical defects the transplantation of fascia, aponeurosis, and tendon is a valuable surgical procedure.
2. Transplants of these tissues when given an adequate supply of lymph continue to live practically unchanged.
3. They heal to whatever structures they are placed in contact with by ordinary scar. The strength of this scar depends on the degree to which the surfaces which are in contact are denuded of areolar tissue and scarified, and on the area of these surfaces.
4. The employment of these tissues as transplants in the form of sutures removes the element of chance which attends healing by scar-tissue.

SUBMAXILLARY SALIVARY CALCULUS.

By HAMILTON BAILEY, London.

Salivary calculus, the Cinderella of the stones to which human secretory and excretory mechanisms are heir, owes its lowly position in the surgical estimation to the fact that it is never a direct cause of death. Sometimes, however, it is a source of much pain and very considerable inconvenience.

The populace of the East End of London (as revealed by the practice of the London Hospital) are rarely afflicted with stone in the parotid gland or its duct; nevertheless submaxillary salivary calculus is relatively frequent, the ratio being a little more than 50 to 1. Christopherson[1] observes that, in the Sudan, parotid are much commoner than submaxillary calculi.

This paper is founded upon 32 cases of stone in the submaxillary salivary apparatus which have, with the exception of one case, been collected from the out-patient department and the records of the in-patient department of the London Hospital.

Composition and Etiology of the Calculi.—Chemical analysis has shown that submaxillary stones and the 'tartar'[11] which collects upon the teeth are almost identical in composition. Both are mainly composed of phosphates and carbonates of calcium, together with small quantities of calcium fluoride and magnesium phosphate, and an occasional trace of sulphocyanide of potassium. These are combined in both instances with about 7 per cent of animal matter. Similarly the bacteriological[5] examination reveals that both are swarming with micro-organisms.

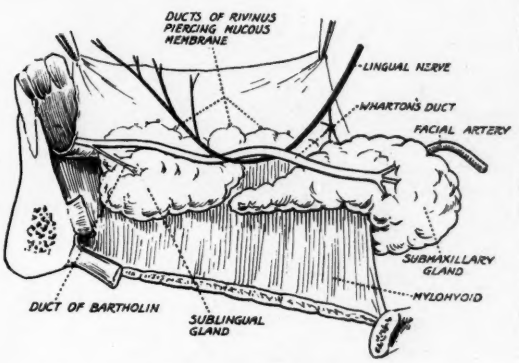


Fig. 238.—Dissection to show Wharton's duct and the structures in relation to it. (*After Allen Thompson.*)

It has been suggested that salivary calculus is due to a foreign body finding its way down the salivary duct. In support of this view a fish-bone has been seen in the centre of a calculus removed from Wharton's duct, and a feather[3] causing obstruction has been picked out of Stenson's duct. Nevertheless these rare instances prove no more than the hair-pin, pieces of catheter, or other foreign body occasionally found within a stone of the bladder. Salivary calculus is an irreversible colloidal adsorption compound sharing with its more illustrious sisters, renal, biliary, pancreatic, and prostatic stones, a certain degree of indefiniteness as to precise etiology.

Some Points in the Surgical Anatomy and Physiology of the Submaxillary Gland.—The submaxillary gland, riding astride the posterior free border of the mylohoid, is divided into two portions: a cervical which occupies the submaxillary triangle of the neck, and a buccal which lies beneath the mucosa of the floor of the mouth. The cervical portion constitutes more than two-thirds of the total gland.

The relationships of the buccal lobe are shown in *Fig.* 238. Wharton's duct, traced backwards, will be seen to divide at the hilum into three primary divisions. These divide and subdivide to drain the 1500 lobules[4] which constitute the parenchyma. A section through the ampulla of Wharton's duct is shown in *Fig.* 240, and *Fig.* 241 is a similar section midway down the same duct. A notable feature in the structure of the duct is the complete absence of musculature. One may therefore surmise that the passage of a stone along the duct, or, indeed, the normal ejection of saliva, must be accomplished by the pressure of the secreted saliva within the gland, aided perhaps by contraction of the muscles which constitute the floor of the mouth. This pressure is considerable. Leonard Hill[7] has demonstrated that, if a manometer is tied into Wharton's duct, the pressure registered when the gland is in full activity may be greater than the arterial blood-pressure.

Fig. 239.—Stones in the submaxillary gland.

Clinical Features.—

Sex.—Males were nearly three times more commonly affected.

Age.—The age varied between 16 and 65.

Calculi may be present in the submaxillary gland and produce no symptoms. In this respect they may be compared with 'silent' renal and biliary stones. *Fig.* 239 shows calculi found accidentally in a radiographic examination. There were no symptoms referable to the stones, and there were no signs when the submaxillary glands were palpated.

Spasmodic Pain (*'coliques salivaires'* of the French authors) typically occurs at the commencement of a meal. In more than 40 per cent of the cases in which pain was a feature the patient stated that it occurred before or (more often) during mastication. This pain is often severe, and it is described by the patients as like toothache.

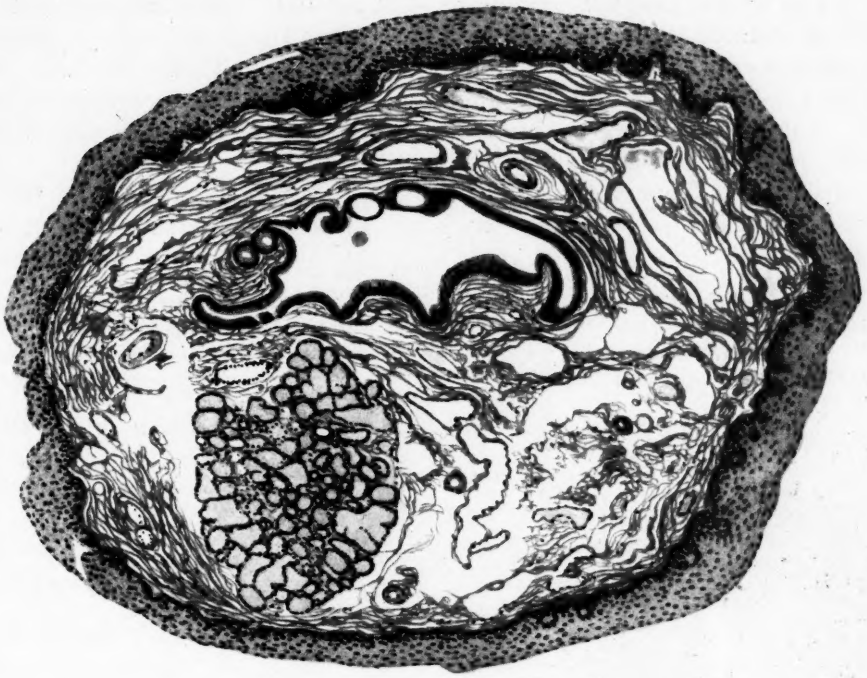


FIG. 240.—Transverse section through the ampulla of Wharton. (A prolongation of the sublingual gland into the papilla is shown.)

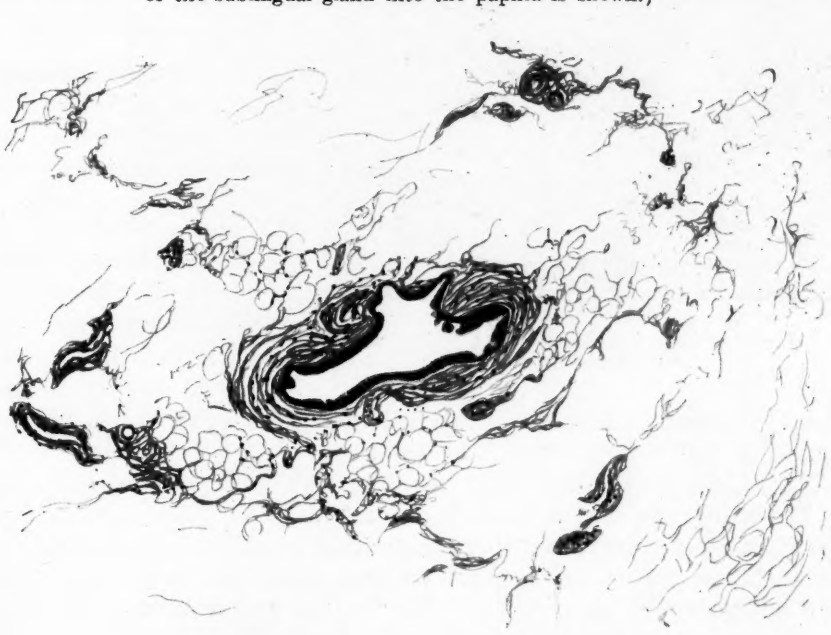


FIG. 241.—Transverse section through the middle of Wharton's duct. Sections stained with van Gieson and iron hæmatoxylin. There was no muscle demonstrable in the sections of Wharton's duct examined.

As a Cause of Lingual Neuralgia.—The intimate relationship of the lingual nerve to Wharton's duct explains the fact that the pain which accompanies the passage of a submaxillary stone may be referred to the tongue. In the case of a female of 22 under observation, this referred pain was described as "like a needle shooting down the side of the tongue". In this case the calculus was passed spontaneously.

A Swelling Beneath the Mandible is often a leading feature of the case. Variations in the size bearing a relationship to meals is pathognomonic of this condition.

Case 1.—A barber, age 61. For forty years he had noticed a swelling in the right submaxillary region, "most noticeable after eating gooseberries or anything tart". For four months the swelling has been larger and very painful. A large salivary calculus was removed from the posterior portion of Wharton's duct.

FIG. 242.—A method of palpating the submaxillary gland.

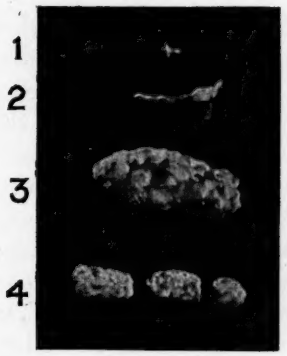
A Swelling in the Floor of the Mouth.—This is not commonly the chief complaint of the patient. It usually signifies that the stone is just behind the ampulla of Wharton's duct.

In general, it may be said that an aggravation of the symptoms owing to secondary infection is the most important factor in determining the patient to seek relief.

Physical Examination.—The orifices of Wharton's ducts are inspected with the aid of a pocket torch, and the two sides compared. In a large number of cases of salivary calculus there is some aberration in the orifice of the affected side. In cases where secondary infection has supervened, the ampulla is inflamed, and sometimes pus can be seen exuding from the duct. Very occasionally a stone impacted in the ampulla will be observed (*Fig.* 243).

A dry swab is inserted under the tongue, and a pinch of salt or, better, some lemon-juice is placed upon the dorsum. The patient is then asked to move the tongue about until he tastes the substance introduced, keeping the swab in place with his finger. He now opens his mouth and rotates the tongue upwards and backwards. The swab is removed, and the dried floor of the mouth again inspected in a strong light. Saliva can be seen flowing, occasionally being ejected, from Wharton's ducts. In cases of calculus impacted in Wharton's duct there will be little or no secretion from the affected side (*Fig.* 243).

SUBMAXILLARY CALCULI



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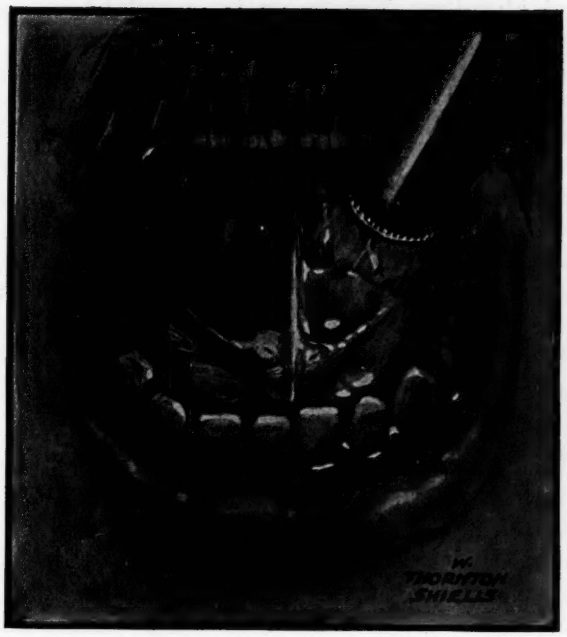

b

FIG. 243.—*a*, Specimens of calculi. 1, Calculus extracted from the ampulla of Wharton. 2, Calculus found in the hilum of the submaxillary gland after removal of the gland. Its shape suggests that a foreign body lies within. (*Specimen kindly lent by Sir Hugh Rigby.*) 3, Calculus removed from the posterior third of Wharton's duct. 4, Calculi extracted after slitting up Wharton's duct.

b, Stone impacted immediately behind the orifice of the right duct of Wharton. The patient is a man of 47. He is sucking a piece of gauze soaked in lime juice, which was placed upon the dorsum of the tongue. At the same time a dry swab was inserted under the tongue. This has just been removed, and a pocket torch illuminates the floor of the mouth. Saliva is flowing from the left Whartonian orifice and is beginning to collect in the sulcus to the left of the frenum linguæ. The corresponding sulcus of the right side remains dry, for the duct is blocked by a tiny stone which can be seen shining through the mucosa.

As the submaxillary gland is composed of two portions, one above and one beneath the mylohyoid muscle, there can be but one efficient method of examining the whole gland, and that is by bimanual palpation (*Fig.* 242).

If, in a case of a doubtful enlargement in the submaxillary triangle, it is ascertained that there is a contiguous intrabuccal and cervical swelling, this is good evidence that that swelling is an enlarged submaxillary salivary gland.

A stone in the anterior two-thirds of Wharton's duct is easily palpated, and can readily be shown by an X-ray through the floor of the mouth; it is passed spontaneously in a fair percentage of cases, and in the remainder it can be extracted with comparative ease. A stone impacted in the posterior third of the duct is much more difficult to detect clinically, to show radiographically, and to treat effectively. Attention is therefore especially directed to palpation of the posterior third of Wharton's duct.

A Method of Palpating Wharton's Duct.—The patient's head is flexed and inclined slightly to the affected side in order to relax the musculature. The index finger is inserted into the mouth, the pulp of the finger being placed upon the internal alveolus. The finger is passed backwards, following the alveolus until the extreme posterior extremity is reached. The finger (now insinuated between the alveolus just behind the last molar tooth and the side of the posterior third of the tongue) is rotated through a right angle, so that the pulp of the finger is directed downwards. In conjunction with the fingers of the other hand beneath the jaw, the whole course of Wharton's duct is palpated from behind forward. In about one out of four patients this manœuvre brings on retching, but even in this event the valuable information required is elicited before any severe discomfort is experienced.

The sounding of Wharton's duct has a limited field of usefulness. It is sometimes of value in the type of case depicted above. Bowman's nasal-duct probe and a urethral guide are the instruments best adapted for the purpose.

Differential Diagnosis.—

1. *From Peridental Suppuration.*—Patients suffering from salivary calculus often attribute their pain to toothache. Selby[10] records that nine cases of salivary calculus were referred to him as dental root abscesses for radiographic examination.

2. *From Cervical Lymphadenitis.*—The swelling in the submaxillary triangle (due to an enlarged cervical portion of the submaxillary salivary gland) is liable to be mistaken for submaxillary cervical lymphadenitis. The differential diagnosis between enlarged submaxillary lymphatic glands and the submaxillary salivary gland lies in bimanual palpation.

Case 2.—Female, age 38. Fifteen months previously she had an attack of 'neuralgia'. She visited a dentist and had two teeth extracted (right). Soon after a lump appeared under (right) lower jaw. For one year this has been treated by painting with iodine. Bimanual palpation showed the swelling to be the cervical portion of the submaxillary gland, the buccal portion being similarly enlarged. X-ray examination revealed a calculus in the extreme posterior portion of Wharton's duct.

3. *From a Neoplasm of the Submaxillary Gland.*—The type of case in which this differential diagnosis has to be made is the elderly individual with a mass of stones in the gland itself. The age of the patient, the stony hard

consistency of the gland, the irregularity of the contour, all help to strengthen the suspicion of malignancy.

The prostate gland may be taken as a parallel example. The differential diagnosis between prostatic calculi and carcinoma is sometimes impossible by clinical methods. Radiography, both in the case of the prostate and the submaxillary gland, has to a very large measure cleared up this difficulty.

In the same way light is often shed upon that even more perplexing problem, the differential diagnosis of submaxillary stones from a mixed tumour of the submaxillary gland.

When acute inflammation supervenes in a case of duct obstruction due to salivary calculus, the following conditions enter the clinical picture.

1. *Simulating Acute Primary Parenchymatous Glossitis.* — Stephen Mackenzie,[9] in 1881, reported a case of a lad sent from Victoria Park Chest Hospital to the London Hospital with respiratory obstruction due to an acute enlargement of the tongue. The patient was given ice to suck, and provision was made for immediate tracheotomy should this measure prove necessary. The following morning the pain and swelling had considerably diminished, and the patient produced a salivary calculus which he had extracted from his mouth during the night.

W. H. Haskin[6] records the case of a female, age 42, who sought relief for an enormous swelling of the tongue and enlarged glands of the neck, accompanied by fever. Three incisions were made into the dorsum of the tongue. Later, as the swelling did not abate, four more incisions were made. Finally, after the acute symptoms had subsided, a large calculus was found in Wharton's duct and removed therefrom.

2. *Simulating Ludwig's Angina.*—The following case is included in this series :—

Case 3.—Clerk, age 35, was admitted during September, 1921, into Liverpool Royal Infirmary. For two days he had had pain in the neck and difficulty in opening the mouth. On examination there was a brawny swelling of the neck, and pyrexia. Multiple incisions were made into the subcutis of the neck. Later, whilst the patient was convalescing, he spat out two fragments of calcareous material which proved to be a fractured submaxillary salivary calculus.

Three weeks after leaving hospital he was again troubled by a swelling in the neck. This time the symptoms were aggravated by the taking of food, and the swelling was confined to the right side beneath the mandible. He was again admitted, and the submaxillary salivary gland was extirpated.

Certain cases of peritonsillar abscess invade the submaxillary region and infiltrate the tissues beneath the angle of the jaw. Therefore, when dealing with the type of case under consideration, peritonsillar abscess should always be excluded.

Complications.—

Infection.—Calculi must produce stasis of the salivary flow. Consequently retrograde secondary infection is likely to, and almost invariably does, supervene. Acute spreading infection is a potential danger as long as there is a stone present in the salivary apparatus. In the six cases in this series where the gland was extirpated, histological examination showed chronic inflammation and fibrosis.

Carcinoma.—Carcinoma of the submaxillary gland is exceedingly rare. Up to the end of 1923 there were only twenty cases on record.[2] There is very little evidence to show that calculi predispose to this condition.

Stricture of Wharton's Duct.—This gives rise to symptoms identical with obturation by calculus. The stricture may follow suppuration around a calculus; probably, however, it is more frequently a sequela of extraction of the calculus from the duct, especially if the incision into the duct is not longitudinal.

Case 4.—Female, age 31. Twenty-four months ago a salivary calculus was removed through the mouth. Since then there had been intermittent attacks of salivary colic and swelling of the submaxillary gland.

The duct was catheterized, but this gave no relief. Later, the anterior portion of the duct was slit up, but the symptoms soon returned. The gland was therefore extirpated. No calculus was found.

Pathological report: Chronic inflammation of submaxillary gland.

Occasionally this stricture supervenes upon conditions other than calculus. Wharton's duct can usually be traced lying over the anterior aspect, but taking no part in the formation, of a ranula. This relationship renders Wharton's duct liable to injury during the excision of a ranula.

Case 5.—Male, age 20. Typical large unilateral ranula, treated by cutting away anterosuperior wall, evacuating contents, and scraping the remainder of the sac. A few weeks later "the submaxillary gland used to swell up to an enormous size, and the patient was temporarily unable to eat". The case has been lost sight of.

Radiology.—Submaxillary salivary calculi, being rich in mineral salts, usually cast a good X-ray shadow, but, as in other forms of calculi, the density of the stone varies. Rays directed from beneath the chin on to a plate or a dental film within the mouth demonstrate a stone in the anterior two-thirds of the duct; but as a stone in this situation is usually found readily by clinical methods, the X-ray picture is often a matter of academic interest only. A stone in the posterior third of Wharton's duct, especially at its junction with the submaxillary gland, is, as has been shown, sometimes a difficult clinical problem. It is in these cases, and in stones of the submaxillary gland itself, that an X-ray is almost indispensable. The lateral X-ray is the only reliable method of demonstrating a calculus in these situations. Even when a stone is demonstrable in the anterior two-thirds of the duct, a lateral X-ray to eliminate other calculi further back would prove a highly satisfactory measure.

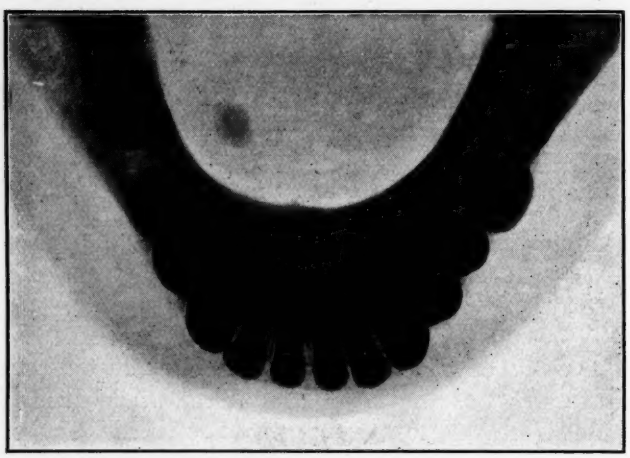

FIG. 244.—Stone in anterior third of Wharton's duct. (*M. H. Jupe.*)

Fig. 244 shows a stone in the anterior two-thirds of Wharton's duct; *Fig.* 245 a lateral X-ray of a stone in the posterior third of Wharton's duct—'the difficult position'; *Fig.* 239 multiple calculi in the submaxillary gland.

Treatment.—

1. *Expectant Treatment.*—In three cases under observation in this series, to the patient's surprise and relief a stone was passed spontaneously.

Expectant treatment consists in ordering a simple mouth-wash and examining the patient at intervals. Antispasmodics may be administered, but, observing that there is no musculature in the walls of Wharton's duct, only a general sedative action can be expected. Belladonna should be avoided, for it inhibits the secretion of the salivary glands—the motive power which drives the calculus onward.

Expectant treatment is especially indicated when there are no signs of suppuration in a case of a calculus not larger than an orange pip, situated in the anterior two-thirds of Wharton's duct, and X-ray examination has shown this calculus to be solitary.

FIG. 245.—Calculus in commencement of Wharton's duct. (*G. Vilvandré*)

2. *Slitting up Wharton's Duct.*—This can be accomplished under local anæsthesia. The indications are: (*a*) Stone in the anterior two-thirds of the duct after expectant treatment has failed. (*b*) Stone in the anterior two-thirds of the duct with severe secondary infection. (*c*) 'Ball-valve' stones of the posterior third of the duct. An example of this was seen in a patient who had a stone in the posterior third of Wharton's duct, in whom expectant treatment failed. On the day elected for the removal of the stone it had apparently slipped back into the gland, for it was no longer palpable. In such a case, after the duct has been slit up, expectant treatment controlled by radiology is again instituted.

3. *Treatment of a Stone Impacted in the Posterior Third of Wharton's Duct.*—Occasionally a stone in this position is difficult to remove. Local anæsthesia is unsatisfactory in these cases. A general anæsthetic through a Junker should be administered. Doyen's mouth gag is placed in position on the non-affected side. Swabs, such as are used by dentists, inserted within the cheeks, are of value to minimize the collection of saliva. A suction apparatus would prove an ideal method of keeping a clear field. A stitch

through the anterolateral part of the tongue is a good retractor of this organ, which tends to occlude the view. A head light is an advantage.

It is first of all essential to 'fix' the stone. This may be accomplished by one of the following methods :—

a. Lane's tissue forceps are applied in such a way that the teeth close upon the tissues beneath and behind the stone within the duct.

b. A stitch is passed behind and beneath that part of the duct containing the calculus. A curved needle on a holder is used ; but the needle should previously have been passed through a flame in order to remove the temper. If the needle breaks in this confined space it is difficult to extract the fragments. The needle which has had the temper removed has the additional advantage that it can be bent to such an angle as to suit the particular case.

c. The stone may be fixed by pressing it against the mandible (C. B. Lockwood[8]).

An incision is now made over the stone, keeping as nearly as possible to the long axis of the duct, in order to avoid subsequent stricture. The stone is best extracted with the aid of a scoop : forceps tend to crumble these soft calculi.

4. *Extirpation of the Submaxillary Salivary Gland.*—A satisfactory incision for this operation is that for ligature of the lingual artery. The indications are : (*a*) Multiple calculi within the gland giving rise to symptoms ; (*b*) Long-standing cases of obstruction due to a Whartonian calculus, especially if the calculus is a recurrence ; (*c*) Chronic inflammation of submaxillary gland which has persisted after removal of the stone which caused it ; (*d*) Stricture of Wharton's duct after dilatation has failed.

The results of this operation are highly satisfactory. There is no instance in the records of the London Hospital of calculus recurring in the remaining salivary glands, and the patients are in no way inconvenienced by the loss of a submaxillary gland.

I beg to thank the members of the staff of the London Hospital for the many advantages I have been afforded. I am also greatly indebted to the sister in charge of surgical out-patients, without whose help the material for this paper could not have been collected.

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STRUCTURAL VARIATIONS IN THYROID METASTASES IN BONE, WITH REFERENCE TO BENIGN METASTATIC GOITRE.

By F. GORDON BELL, Edinburgh.

Much interest is attached to secondary thyroid tumours of bone, especially the variety which appears to present a normal or benign thyroid structure. The interest is still greater when the thyroid gland presents, or appears to present, no departure from the normal detectable on physical examination, or at most is the seat of a colloid or adenomatous change. Such cases have been interpreted in the past, chiefly through the influence of Cohnheim,[1] as examples of metastasis from a normal or benign thyroid—*benign metastatic goitre*; and if this interpretation be accepted, it allots to the thyroid a unique place in the range of surgical pathology, for no other structure has been credited with a like potentiality. It seems necessary, therefore, to weigh the evidence which may be taken to support Cohnheim's conception, and this may be considered under the three following heads :—

1. *Certain structural and functional features* of the thyroid gland require consideration as having a possible bearing on the problem. Ewing[2] points out in a general review of the principles of thyroid pathology that the gland possesses a remarkably abundant blood-supply capable of great variation, the circulation between the alveoli is of a sinusoidal character, and the glandular epithelium is brought into an unusually intimate relation to the vascular endothelium owing to the absence of a basement membrane. Great variations in function are closely related to these structural peculiarities, and in response to various stimuli the glandular cells may undergo enormous hyperplasia, as in toxic exophthalmic goitre, where the richness of the cell content may approach or surpass that of many frankly malignant tumours, and under certain conditions may return towards the normal, while under other circumstances the glandular epithelium may atrophy, and regenerate later. Consequently, it may be assumed that the thyroid cell proper possesses exceptional potentialities with regard to size, number, and functional activity, and in virtue of these attributes may possibly be rendered more mobile owing to its intimate relation to the endothelium of the sinusoidal blood-spaces through the absence of a basement membrane, and may thus pierce the slender barrier and enter the blood-stream. Once having entered the circulation, it is easy to suppose that such emboli, composed of normal or abnormal thyroid cells, may readily be deposited and grow in other parts, for the exceptional capacity of thyroid tissue to survive and to function in new surroundings is amply demonstrated by the success attending thyroid grafting. In this connection it will be interesting to observe whether grafts of admittedly normal thyroid tissue—placed, for example, in the head of the tibia, which is a popular site for

grafting at present—display any future tendency to erode the bone and to act in a malignant fashion as the so-called benign thyroid metastasis commonly does.

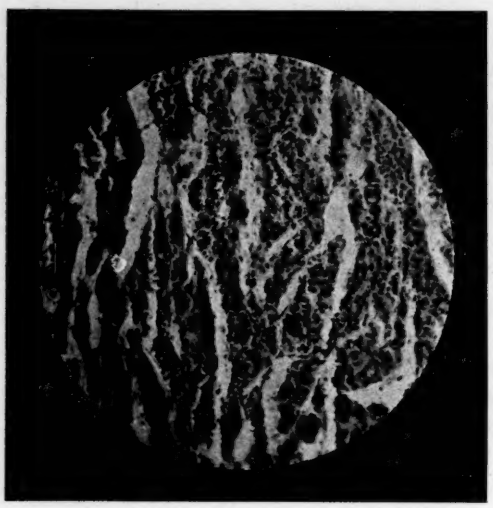

FIG. 246.—Fœtal adenoma. Reproduced to show the sinusoidal character of the circulation.

It is convenient here to refer to certain other histological and developmental features. The thyroid possesses a reserve supply of undeveloped glandular epithelium which, in response to a physiological call, may develop and assume adult characters. Some pathologists, especially Wölfler, have allotted great importance to these reserve islets, sometimes called Wölfler's rests, and hold them responsible for the development of thyroid adenomas, which in turn may give rise to metastasis, benign or malignant. Whatever be the rôle of these islets, it is an undoubted fact that secondary thyroid tumours in bone often display a structure closely resembling that of the fœtal or developing thyroid or of the fœtal adenoma. The sinusoidal character of the circulation is often particularly observable in adenomata (*Figs.* 426, 247), and the endothelial lining of the blood-spaces may be so attenuated that the alveoli appear to be literally bathed in blood. This feature is exaggerated in the malignant adenoma, and accounts for the fact that the dissemination of thyroid carcinoma usually takes place by the blood-stream. It is conceivable that an imperfection of the sinusoidal endothelium, possibly aided by, or associated with, some slight trauma or strain, may allow the glandular cells in benign conditions of the thyroid to enter the circulation and give rise to a benign metastasis. Patel,[3] in a paper entitled "Tumeurs benignes du Corps thyréoïde donnant des Metastases", appears to attach importance to the peculiarities and richness of the capillary circulation, and notes the valve-less condition of the thyroid veins, especially the inferior set.

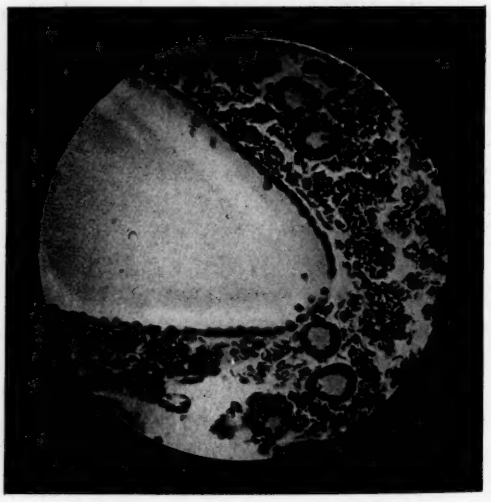

FIG. 247.—Colloid adenoma. Reproduced to show the tenuity of the sinusoidal endothelium. The darkly-staining spindle cells are seen here and there round the large alveolus, but are not detectable round the small alveoli, which are surrounded by blood-corpuscles.

2. *Errors in development* and the osseous inclusion of aberrant thyroid

tissue offer a plausible explanation for some benign tumours apparently unassociated with changes in the cervical thyroid. Such an explanation may hold in the region of the neck in regard to the mandible, sternum, clavicle, and possibly the cervical spine. Radley and Duggan[4] invoke the aid of this theory in the case of a tumour of the clavicle, though a small tumour had been removed from the thyroid two years previously. Possibly Riedel's[5] case, a tumour of the mandible recurring ten years after removal, might be similarly interpreted. 'Accessory thyroids', or misplaced islands of thyroid tissue, may be situated along the line of the thyroglossal tract, behind the sternum or clavicles, and towards the spine, and may conceivably be included in one or other of the bones mentioned, though there are certain anatomical objections. Such an origin can hardly be alleged in the case of the long bones, pelvis, ribs, skull, and lower part of the spine, and it seems necessary to assume that tumours in these situations must have arisen from detached thyroid cells carried by the circulation.

As bearing on this hypothesis, Joll's table mentioned below brings out the significant fact that the bones least likely to include aberrant thyroid tissue are most commonly the seat of metastasis, and of the 44 cases the skull and spine were involved 15 and 12 times respectively, as opposed to the clavicle and sternum 7 and 3 times.

3. *The chief evidence in favour of metastasis from a normal or benign thyroid* is derived from a series of cases reported by various observers where a thyroid tumour in bone has been associated with either a clinically normal thyroid or with some benign condition such as a colloid or adenomatous goitre. Joll[6] has recently tabulated a comprehensive list of these two types, adding a case of his own and making some instructive comments.

The first group is admittedly small, barely reaching double figures, and must be accepted with great reserve in view of the fact that the cases have rarely been checked by an examination of the cervical thyroid that stands criticism. Ewing indicates his scepticism by pointing out that in none of these cases has the supposed normal thyroid been submitted to microscopical examination, and Albert Kocher[7] takes a similar attitude.

The second group, in which a metastasis from a colloid or adenomatous goitre is postulated, is a much larger one. Many of the cases are open to criticism, and even Cohnheim's case, which is classical in that it gave the start to the conception of benign metastatic goitre, was not accepted by some of his contemporaries. In this case the thyroid was generally enlarged and was the seat of a gelatinous or colloid change, and the metastatic tumours in the spine, femur, and lungs were of the same type. Autopsy showed that a portion of the colloid growth had penetrated the wall of one of the inferior thyroid veins. Under such circumstances transplantation of thyroid tissue would readily occur, but it seems necessary to assume an abnormal growth activity on the part of the colloid goitre to enable it to penetrate the wall of the vein. Wölfler[8] expressed his opinion of these cases in words difficult to contravene: "When the glandular cells distributed by metastasis have given rise, in different situations, to tumours which not only grow but exert a destructive action on the bone, the primary tumour should be considered benign neither clinically nor anatomically, even if its malignancy cannot be established by microscopic examination."

It is the writer's object not to embark on any critical analysis of the recorded cases, but to emphasize the facts, which may appear obvious, that physical examination of the neck during life is entirely unreliable, and that superficial inspection of the thyroid at autopsy may readily fail to reveal minute changes within the gland (*see Fig.* 252); and further, to demonstrate by microphotographs that a secondary thyroid tumour of bone of unquestionable malignancy may display a structure, fœtal or adult, hardly if at all distinguishable from that of a normal or benign gland. In such a cellular organ as the thyroid, where the cell content is subject to great variations, both in quality and quantity, within the range of the benign, the difficulty in determining the onset of an early malignant change is greatly enhanced, and the interpretation of the finer shades of malignancy is likely to remain a matter of personal opinion. The extreme view that it is only by complete or even serial section of the thyroid that minute foci of proliferation can be excluded is logically unassailable, but is beyond the range of the practical, and even if carried out would hardly yield any unanimity of opinion in so difficult a field.

THE MATERIAL.

The material available for discussion in this paper is admittedly too scanty for more than tentative conclusions, and is derived from three cases only, but of differing clinical types, which may be briefly summarized.

Case 1 had a frankly malignant goitre on first coming under observation, and in addition had a secondary deposit in a rib.

Case 2 presented the features of a simple enlargement of the thyroid for several years, with recent rapid growth of one lobe as the only suspicious feature, early malignant change being discovered on section and with the microscope. A secondary deposit appeared in the sternum two years after removal of the affected lobe, and, when the patient presented himself for further treatment after the lapse of another two years, the tumour in the manubrium had reached the size of an orange.

Case 3 presented no abnormality of the thyroid discovered during life, metastases manifesting themselves by pathological fracture of the right femur and great enlargement of the left ilium, the thyroid nature of these tumours only becoming evident at autopsy and on microscopic examination. This is the most interesting and important of the three cases, for it belongs to the type that has been the chief prop of the hypothesis that a normal or benign thyroid may give rise to metastasis. All three cases have direct practical bearings.

Case 3 illustrates the important principle that in dealing with an endosteal tumour the possible well-known secondary sources of origin such as the thyroid, breast, prostate, and kidney should be excluded before accepting the tumour as primarily osseous. This is a counsel of perfection, and in the case of a secondary thyroid deposit with no clinical change in the neck the exact nature of the bony tumour can only be determined by exploratory operation. The case is a striking illustration of the futility of depending on a physical examination of the neck to exclude a thyroid origin in the case of a doubtful tumour of bone, for the thyroid showed no abnormality, and only on microscopic examination was unequivocal evidence obtained that the thyroid had given origin to the tumours in the femur and ilium. The writer has recently

observed another case exemplifying the same point. This patient, an elderly man, was referred to the surgical wards for the removal for diagnostic purposes of a hard, enlarged gland in the left supraclavicular region. No primary source was detectable in the abdomen or neck, but microscopic examination showed the gland to be infiltrated with adenocarcinoma of unmistakably thyroid character. Even with this knowledge a further examination of the thyroid was entirely negative. Though an origin from aberrant thyroid tissue is possible in this case, it seems more reasonable to suppose that the parent source in the thyroid gland is still too small to be detectable by palpation.

Cases 1 and 2 illustrate the practical difficulties of this subject when a surgeon is confronted with the problem of dealing with a *single* thyroid metastasis in an accessible situation. How little guidance he obtains from the pathological confliction of ideas is best illustrated by quoting Jaeger,[9] who lays down the following four sets of conditions relative to the thyroid and the metastasis: (1) Malignant thyroid—benign metastasis; (2) Benign thyroid—malignant metastasis; (3) Malignant thyroid—malignant metastasis; (4) Benign thyroid—benign metastasis.

If a surgical belief is based on the first set of conditions, the natural desire to do the best for the patient is strengthened by pathological support, and operation receives full justification if the primary tumour in the neck can be removed. The second set of conditions reduces the problem essentially to that of any primary malignant tumour of bone, with the addition that the benign (*sic*) source also requires attention. The third set renders the problem practically hopeless, and the fourth is the combination that all surgeons would prefer to meet.

Reducing the matter to the practical, and glossing over the lingering uncertainty as to the existence of other latent deposits not revealed by a searching radiographic examination, we may have to deal with a *single metastasis in an accessible situation*: (1) That develops after the removal of a thyroid tumour of low malignancy, of which *Case* 2 is an example; (2) That is associated with a condition of the thyroid such as an adenomatous or colloid tumour which lends itself to removal with every prospect of success; (3) That is associated with a clinically normal thyroid where the exact nature of the bony tumour must remain uncertain till exploratory operation; and (4) That is associated with a definitely malignant goitre which can be removed or is treated by radium or other means. Under these sets of conditions, with the possible exception of the fourth, operation on the osseous tumour is certainly indicated, and in most cases, especially in view of the existing uncertainty as to the exact status of the metastasis *qua* malignancy, should be of a conservative nature.

CASE REPORTS.

Case 1.—Male, age 52. Complained of pain at the root of the neck, passing round the neck and up the sides of the head, of two months' duration, also pain over the ribs on the right side, of several weeks' duration. Examination showed a considerable enlargement of the thyroid, especially on the right side, and the gland was hard and adherent. Over the eighth rib, below the angle of the right scapula, there was a hard nodular swelling the size of a chestnut, evidently growing from the rib. The secondary deposit was excised along with several inches of rib, but the goitre was found inoperable on exploration, and the wound was closed with a view to future treatment by radium.

THE COSTAL METASTASIS.—On splitting the rib a small, solid, fleshy tumour was found expanding and replacing it.

Microscopical.—Generally it presents the features of an adenocarcinoma, destroying and replacing the bone. The cells are mostly spheroidal and are arranged irregularly, though in places they show an attempt to form acini with no lumen or duct-like spaces. There is no trace of colloid, and the general picture gives little suggestion of a thyroid origin, though presenting a superficial resemblance to fœtal thyroid tissue, the solid clumps of columns of cell resembling those of a fœtal adenoma (*Fig.* 248).

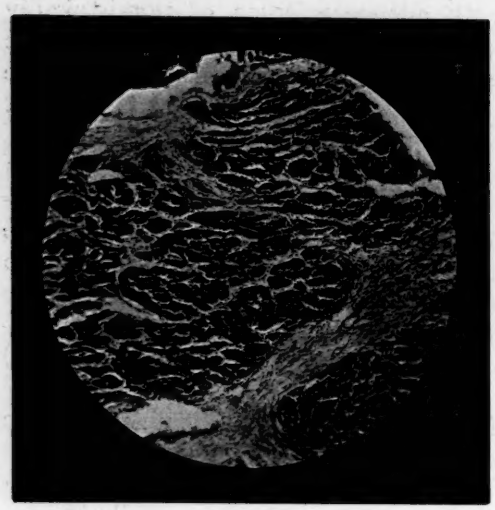

FIG. 248.—*Case* 1. Costal metastasis. Adenocarcinoma; shows typical structure, bearing a crude superficial resemblance to that of a fœtal adenoma.

It is unfortunate that the primary tumour is not available for comparison with the secondary deposit, but the enlargement, hardness, and fixation left no doubt as to its malignant nature.

Case 2.—Male, age 47. Noticed slowly increasing enlargement of the neck for eight years, and applied for treatment owing to a rapid increase in growth on the left side during the last year. Examination showed a symmetrical enlargement of the thyroid, the left lobe displacing the larynx markedly to the right. The enlarged left lobe was resected, the patient making a smooth recovery and returning to his occupation in Caithness. A diagnosis of early malignant change was made on microscopic examination. Two years later he noticed a swelling the size of a pigeon's egg in the upper end of the breast bone, which caused him so little discomfort that he delayed seeking further treatment for another two years, by which time the tumour in the manubrium had reached the size of an orange. As there was no return of the tumour in the neck and the sternal metastasis appeared to be the only one, it was decided to remove it.

OPERATION.—The muscular attachments to the sternum were divided, the 1st, 2nd, and 3rd costal cartilages cut through on both sides, the sternoclavicular joints disarticulated, and the sternum was sawn across between the 3rd and 4th ribs. At this stage the patient's condition became precarious, and the wound was packed with the object of completing the removal at a second stage; but he gradually sank, and died the same evening.

THE THYROID.—The resected left lobe was considerably enlarged, and on section showed marked pathological changes. Its medial part was occupied by a cyst the size of a Tangerine orange, while the solid peripheral part was sharply divided into an area composed of spongy tissue containing colloid, and a larger pale area containing scattered hæmorrhages and not unlike encephaloid cancer, giving the impression that a malignant change had been superimposed on a colloid cystic goitre.

Microscopical.—The spongy tissue shows the features of a simple colloid goitre. The pale, more or less solid area shows in parts marked proliferation and changes in the character of the glandular epithelium, though maintaining the characteristic thyroid structure to such an extent that a cursory examination of one area might fail to note the departure from the normal, or, in other words, might class it as a benign condition. Many of the alveoli are well formed, and are lined by cubical cells secreting colloid. The chief change appears to affect the inter-alveolar cell groups, and in some areas these form solid cellular patches enclosing here and there

small alveoli containing no colloid. The cells generally are larger than normal and stain poorly, and the nuclei are unusually large (*Fig.* 249).

It is noteworthy, as indicating the low grade of malignancy, that no recurrence took place in the remains of the thyroid in the four years between the first and second operations, and microscopical examination of the right lobe and isthmus after death showed merely the features of a simple colloid goitre.

FIG. 249.—*Case* 2. Thyroid. Adenocarcinoma; but preserving a superficially benign appearance. The alveoli are still fairly uniform and contain colloid, but the cells for the most part differ from the normal and show a tendency to form solid patches.

THE STERNAL METASTASIS.—Generally it presents the picture of an adenocarcinoma destroying and replacing the bone, but shows considerable structural variations in different parts. The bulk of the tumour is made up of tissue presenting a general resemblance to the undeveloped thyroid, consisting of columns and clumps of cells suggesting an acinar arrangement without a lumen. In certain areas the cells assume an alveolar arrangement so definite as to render a thyroid origin unmistakable, though colloid is absent. The cells are either irregular or of the characteristic cubical shape. In the areas where active destruction and replacement of bone is going on, the type and arrangement of the cells are so irregular as to make the diagnosis of adenocarcinoma obvious. To summarize, the metastasis exhibits variations in structure, ranging from undeveloped thyroid tissue to definite

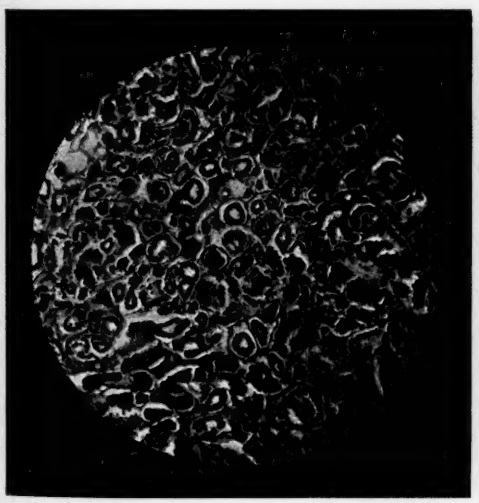

FIG. 250.—*Case* 2. Sternal metastasis. Adenocarcinoma. The majority of the cells are arranged in solid groups, but commencing alveolar formation is evident.

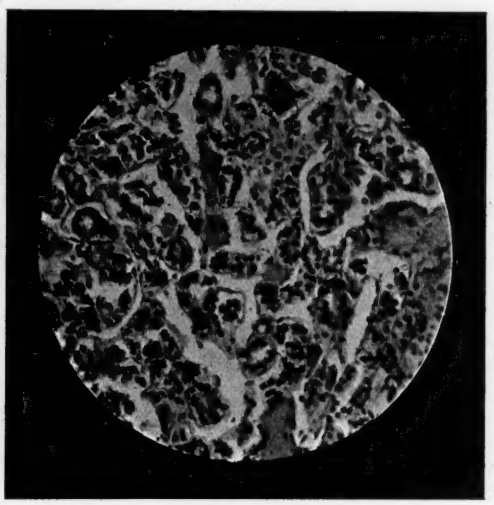

FIG. 251.—*Case* 2. Sternal metastasis. High-power view showing general structure and the tendency to the formation of alveoli lined by cubical cells. Note broad resemblance to developing fœtal adenoma.

adenocarcinoma, with here and there an attempt to reproduce the normal glandular features (*Figs.* 250, 251).

Case 3.—Female, age 48. Had complained of pain in the right hip-joint and difficulty in walking for several months. While confined to bed, the upper end of the right femur fractured spontaneously. A swelling became manifest in the groin, and pain was referred to the distribution of the femoral nerve, and was later succeeded by numbness. A skiagram revealed a fracture of the neck of the right femur, with marked rarefaction of the head and upward displacement of the trochanter. A tumour then developed in the left iliac region and gradually increased in size, œdema of the lower extremities became marked, and death took place two and a half years after the onset of the illness.

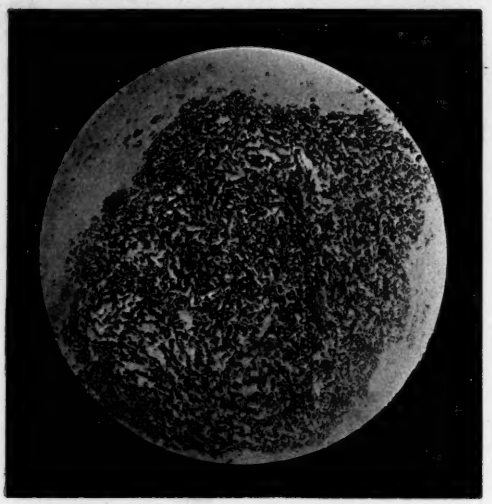

FIG. 252.—*Case* 3. Thyroid. Malignant adenoma. The *entire* proliferating nodule enclosed in fibrous tissue appears in a single low-power field. Several similar areas were present in other parts of the gland.

The post-mortem findings are described below. It is noteworthy that metastasis involved the bones alone, the lungs and lymph nodes escaping.

THE THYROID.—The gland at autopsy showed neither general nor local enlargement, and superficial examination revealed no departure from the normal; but on section the right lobe was found to contain three nodules about the size of a filbert. Two of these were hard and apparently fibrous, and the third resembled an ordinary adenoma.

Microscopically, the main part of the gland shows a more or less normal thyroid structure. The fibrous areas, however, display definite changes. They consist chiefly of fibrous tissue, but enclose masses of glandular cells which differ markedly from those of a normal thyroid or of a typical encapsulated benign adenoma. The cells for the most part have lost their cubical shape and become spheroidal, and are arranged irregularly, but in some areas have a tendency to assume a tubular or alveolar disposition. The vascular network is unusually prominent, and the blood-spaces are large and thin-walled and of the character of sinusoids, the lining endothelial cells being in close relation to the glandular epithelium. Here and there the fibrous capsule contains small groups of compressed thyroid cells, and this may be interpreted either as an attempt to invade the capsule, or to represent outlying portions of thyroid tissue undergoing strangulation.

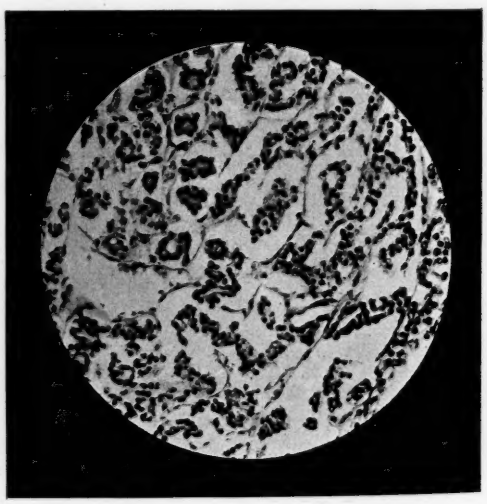

FIG. 253.—*Case* 3. Thyroid. High-power view of same, showing the sinusoids and the shape and arrangement of the thyroid cells.

To summarize, the highly irregular arrangement and change in shape of the cell, the absence of colloid, and the embryonic character of the blood spaces strongly suggest a malignant adenoma (*Figs.* 252, 253).

THE METASTASES IN THE RIGHT FEMUR AND LEFT ILIUM.—

The femur: The head, neck, and both trochanters were completely destroyed and replaced by a large cavity filled with chocolate-coloured fluid, while the acetabulum was filled by a soft, friable, tumour-like material. On section of the femur, the tumour was found to have extended for some distance into the medullary cavity, where it displayed cystic areas.

The ilium: The greater part of the left ilium was completely destroyed by tumour formation, and the iliac fossa was occupied by a large mass which partially filled the pelvis and lay deep to the iliacus and psoas muscles. The left sacro-iliac was disorganized as the result of erosion by the tumour. On section, the mass was found to be cystic, and its appearance was highly suggestive of a cystic goitre.

To summarize, the destructive changes in both femur and ilium were on so marked a scale as to leave no doubt as to the highly malignant character of the invading deposits.

Microscopic Features.—

The femoral metastasis: The solid tissue replacing the upper end of the bone shows for the most part a structure resembling undeveloped and badly-formed fœtal thyroid. The cells are arranged in small groups and columns. An acinar arrangement is easily distinguished, and in some areas the alveoli are well formed, are lined by cubical cells, and contain thin, badly-staining colloid—the thyroid character being unmistakable. Certain areas show a structure exactly reproducing that of the nodules in the thyroid gland already described, with the same tendency to invade the fibrous stroma.

The iliac metastasis: The tumour replacing the ilium shows a generally similar structure, but the formation of vesicles like those of the normal thyroid is in parts much more evident, and in small areas reproduces the features of an ordinary colloid goitre, giving the impression that when the fungating tumour is liberated from the mechanical restraint exercised by the rigid bony tissue, it tends to undergo colloid hypertrophy, while the tissue actively eroding the fibrous and osseous structures retains an undifferentiated type.

To summarize, the thyroid nature of the secondary deposits is everywhere evident, but displays striking variations. The fœtal element predominates, and is hardly distinguishable from the normal developing thyroid; vesicular and colloid formation of the normal type is well marked; and in some areas the structure of the suspicious nodules in the cervical thyroid is exactly reproduced. Certain areas might well be regarded as displaying a benign structure, and illustrate the peculiar tendency of secondary thyroid deposits of a cancerous nature to revert to the normal; but no tumour displaying such obvious malignant tendencies as described above can seriously be regarded as benign (*Figs.* 254, 255, 256, 257).

The histological appearances of secondary thyroid deposits in bone, as portrayed in these three cases, display considerable variations, and this variability depends partly on the type of the parent tumour, partly on the duration of the metastasis, and partly on its local circumstances. One would suggest that in the early stages of a metastasis enclosed within bone the structure is likely to remain of an undifferentiated embryonic type. Later on, the striking tendency of the aberrant thyroid cells to arrange themselves in a more or less normal fashion asserts itself, and this tendency becomes all the more evident if mechanical restraint is removed, when the features of colloid hypertrophy may be superadded. In other words, the life history of a metastasis is likely to follow that of the developing cervical thyroid. Like it, the metastasis may function, as in the much-quoted case of von Eiselsberg,[10] and similarly it may undergo colloid or cystic changes. Hence the examination of one part of an osseous deposit, or examination at one stage of its

development, may prove misleading, owing to the facility with which the thyroid cells assume structural variations.

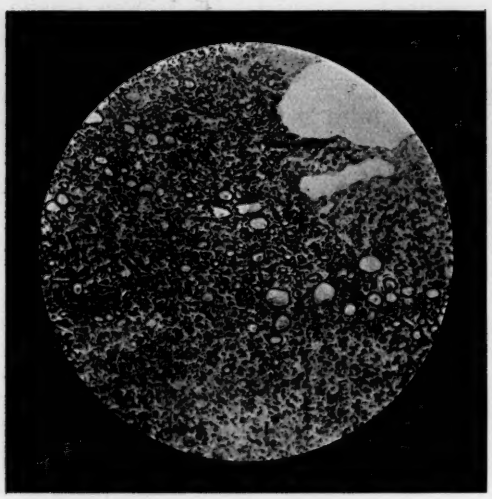

FIG. 254.—*Case* 3. Iliac metastasis. Shows the general structure typical of both this and the femoral metastasis. Solid groups of cells preponderate, but early alveolar formation of a regular type with colloid is well seen.

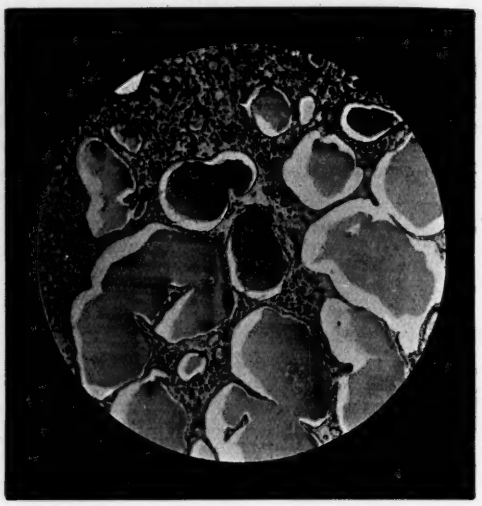

FIG. 255.—*Case* 3. Iliac metastasis. Shows various stages in development; solid groups of cells, small alveoli containing colloid, and dilated alveoli filled with darkly-staining colloid.

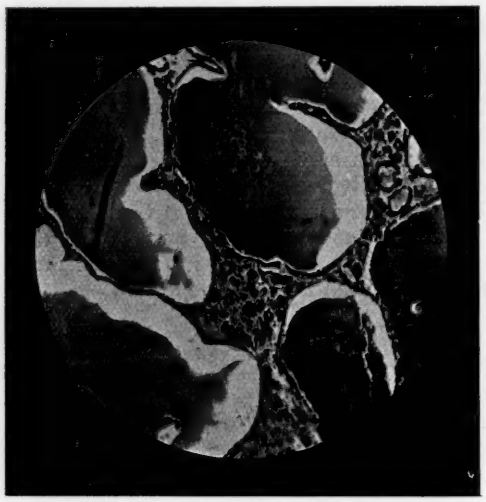

FIG. 256.—*Case* 3. Iliac metastasis. High-power view showing changes characteristic of a simple colloid goitre.

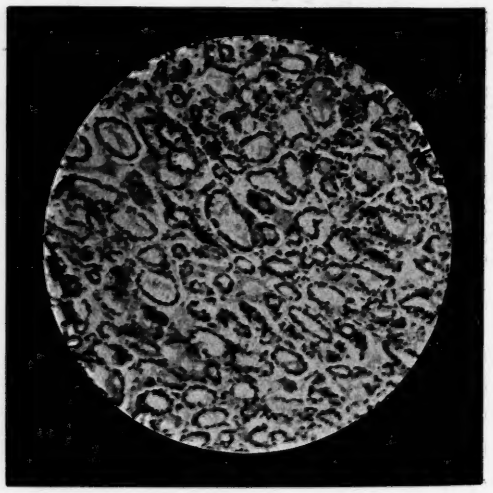

FIG. 257.—*Case* 3. Iliac metastasis. Another area showing well-marked alveoli of uniform size with commencing colloid formation.

Figs. 254 to 257 are reproduced to show the tendency of the metastases to revert to a normal or benign structure; but, as noted in the text, other areas exactly reproduce the structure of the nodules in the thyroid, and are regarded as certainly malignant.

The tendency displayed by secondary deposits of a carcinomatous nature to assume a structure resembling that of the normal thyroid—a feature first emphasized by Eberth and designated "the return towards the normal"

by French writers—requires most careful consideration before a secondary tumour can be accepted as having a normal or benign structure, and more stress should be laid upon the reaction produced by the deposit on the surrounding tissues and its capacity of eroding and destroying the bone than upon its histological characters.

SUMMARY.

The material is too scanty to permit of any formal 'conclusions', but the cases raise certain points which merit consideration :—

1. Metastatic tumours of bone of thyroid origin exhibit considerable histological variations.

2. An embryonic or fœtal structure appears to form the basal type, and this may develop towards a normal thyroid structure with formation of colloid, or may assume frankly malignant characters. All these variations may be represented in the same tumour.

3. The fact that secondary tumours may exhibit a striking tendency to the formation of a structure practically indistinguishable from that of the normal or benign thyroid—"the return towards the normal"—probably provides an explanation for some of the so-called benign metastatic tumours.

4. This feature should be coupled with the fact that the proliferative changes in the thyroid indicative of malignancy may be so minute or even microscopical as to be readily missed in the absence of a thorough histological examination, and still more readily if reliance is placed on a clinical examination.

5. The sinusoidal character of the thyroid circulation, seen to great advantage in adenomata, may have a direct bearing on the origin of benign metastatic tumours.

6. The true criterion as to the benign or malignant nature of thyroid osseous deposits should be based on their destructive behaviour towards the surrounding bone rather than upon their histological characters.

Cases 1 and 2 were under the care of the late Professor Alexis Thomson in the Royal Infirmary, Edinburgh, and for the records of *Case* 3 I am greatly indebted to Dr. H. D. Wright, now of University College Hospital Medical School.

The microphotographs are the work of Mr. Pettigrew, Technical Assistant in the Department of Surgery, Edinburgh University.

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A NEW TECHNIQUE FOR ARTHRODESIS OF THE TARSAL JOINTS.*

By ALEXANDER MACLENNAN, Glasgow.

The problem of dealing with a paralytic foot resulting from infantile paralysis has been adequately solved by the performance of arthrodesis as recommended by Dunn. Unfortunately these cases are often complicated by deficiency in growth of the entire leg, and especially in that part of it below the knee. In such cases (*Fig.* 258) there is little benefit to be gained by stabilization of the tarsal joints. An arthrodesis of the ankle-joint added to that of the tarsal joints, with fixation of the foot in extreme extension (equinus position), is then advisable, as it adds the length of the foot to that of the leg.

Fig. 258.—To illustrate the condition suitable for this operation.

This operation as described by Mikulicz adequately fixes the foot, but it necessitates the resection of the tarsus, and thereby fails to gain the full possible lengthening of the leg. The operative technique about to be described has the advantage of producing the minimum of shortening of the foot, and, while it fixes the os calcis, also allows of some pressure being put on the heel, and so reduces that on the balls of the toes. This operation should not be performed until the patient has reached nine years of age, unless it be combined with a graft of bone extending from the tibia to the metatarsus.

In children under nine years much of the tarsal bone is cartilage; hence an arthrodesis is difficult to achieve in them. During the period of waiting, the foot is put up if necessary in successive plaster-of-Paris casings until a complete equinus position is obtained. Finally, a celluloid splint is moulded to a cast of the foot, and the child becomes accustomed to walk on the balls of the toes until the requisite age is reached.

The operation is carried out as follows: A tourniquet is applied to the thigh. A dorsal incision to the outer side of the long flexor of the great toe extends obliquely upwards from the space between the heads of the first and second metatarsal bones to the lower tibio-fibular joint. This incision reaches

* A communication made to the Association of Surgeons, Liverpool, May, 1924.

down to the bones, avoiding as much as possible the dorsal cutaneous nerves and the dorsalis pedis artery. The tendinous slip of the short extensor passing to the great toe crosses the incision; it is not worth while conserving it. Tfie first and second motatarsal bones are separated by the knife from each other, a saw or osteotome is inserted, and the cuneiform, scaphoid, and astragalus are split vertically. In such feet the bones are usually much rarefied and soft. By the aid of retractors the split in the foot is forcibly widened, exposing all the joints (*Fig.* 259). The various joints are erased by the osteotome and sharp spoon. The only difficulty in the operation will be found in rendering the obliteration of the astragalo-calcaneal joint complete. If pieces of the very friable bone become detached during the operation,

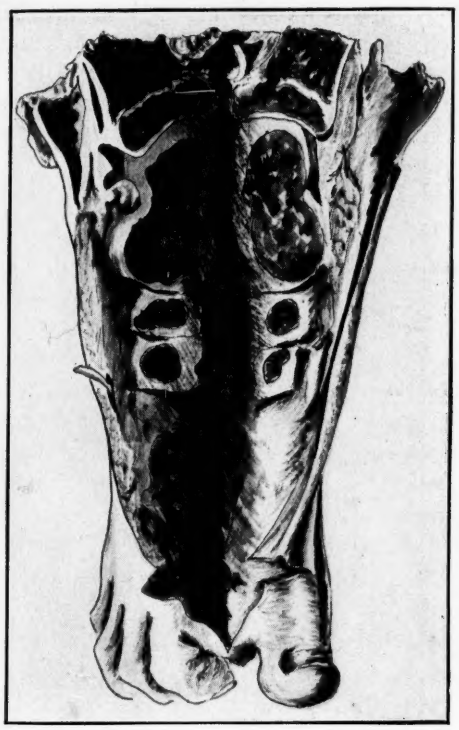


FIG. 259.—Specimen of split-foot from a child of 5 years, showing the free access to the tarsal joints.

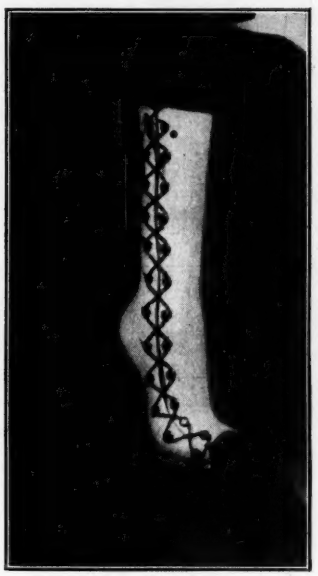


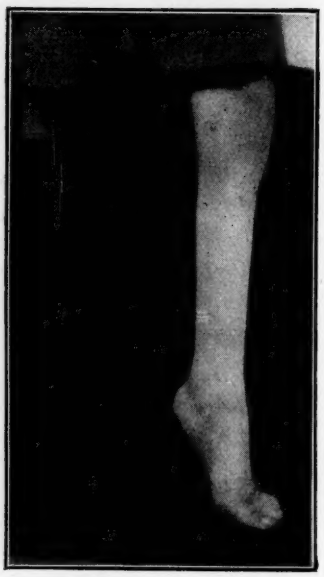
FIG. 260.—Shows arthrodesed foot in celluloid case.

they should be carefully preserved, and should be inserted into the wound before the incision is closed. Ligatures are not usually required, as the hæmorrhage is not serious. A few subcutaneous catgut sutures may be inserted, and the wound closed. The foot is put up with a lateral straight wooden splint, to be followed, when the sutures are removed in a fortnight's time, by a plaster-of-Paris case, which should be retained for eight weeks. After six weeks the child should be encouraged to walk, so as to stimulate the formation of the bone. A celluloid splint should then be fitted as shown in *Fig.* 260.

In none of the cases have there been any untoward symptoms. Little pain is complained of, and there has been practically no hæmorrhage. The external appearance of the foot is unaltered, and its length not appreciably

diminished. When fixation has been achieved, after a lapse of about six months, an artificial boot may be made so as to distribute the pressure between the projecting heel and the balls of the toes. The various illustrations will render further description of the procedure unnecessary (*Figs.* 261, 262, 263).

Altogether seven cases have been done on children between the ages of 10 and 12. In the first case the incision extended from the middle of the sole of the foot, between the first and second toes, up to the ankle-joint. The incision has now been curtailed to the dimensions referred to, as an incision



FIGS 261, 262.—To show foot after splitting operation.

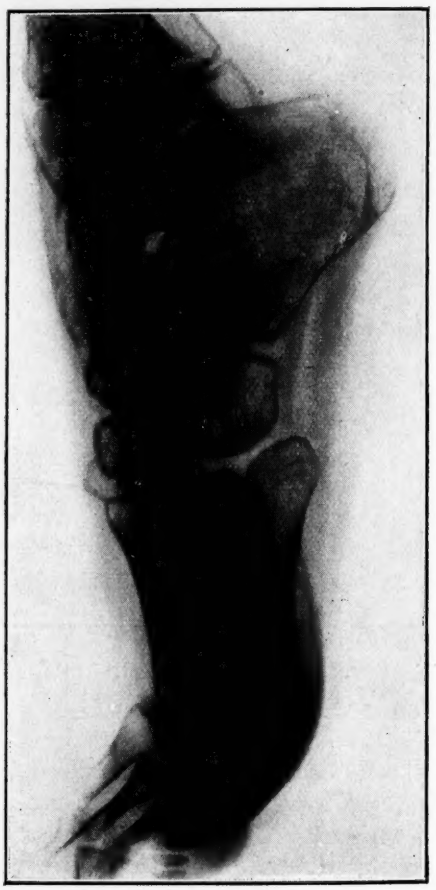


FIG. 263.—Radiograph of foot shown in *Fig.* 261 6 months after operation.

into the sole of the foot was found to be unnecessary. The children walk without support of any kind other than a stiffened boot.

The only alternative to the operation would seem to me to be amputation.

CYSTINURIA WITH CALCULUS FORMATION.

By HAROLD C. EDWARDS, London.

Cystin calculus must be an extremely rare condition. Since Woollaston first discovered a cystin stone in the bladder of a child in 1810, only some 117 cases have been recorded. It is computed that 2½ per cent of cystinurics develop stones, but this figure is probably high on account of the large number of unrecognized cases of cystinuria. The following case is of additional interest in that the passage of cystin crystals by the kidney is intermittent.

The patient is a man of 36, of medium height and build, giving a history of quinsy when three years old, and with nocturnal enuresis up to the age of seven. He first suffered symptoms of stone in 1901, when he had a severe attack of renal colic, and passed small stones per urethram. Two years afterwards he was operated upon for acute appendicitis with abscess. From 1903 to the present time he has had numerous attacks of renal colic, and has passed a large number of stones varying from minute dimensions to the size of a pea. The attacks have occurred at intervals of varying duration, sometimes of two to three months up to nine to twelve months. An attack may last anything from two hours to six weeks. In the long attacks, pain is subacute, with severe exacerbations

He has always suffered from a weak digestion, and during the last twenty years—i.e., since the incidence of the renal complaint—he has been troubled with flatulence and a feeling of weight in the epigastrium. This is greatly exaggerated before an attack of renal colic, and forms an actual prodroma. Blepharitis, with much blepharospasm, and profuse watering of the eyes, are also prodromata. This condition reaches a climax during the renal attack, and slowly subsides.

He has often suffered from rheumatism affecting both knees. For some years he has suffered occasional attacks of acute inflammation, with much pain and swelling of the first joint of either big toe. This seems most liable to occur in the early days of spring, and simulates gouty arthritis. During the early part of such an attack, which lasts about three weeks, it is agony to put the foot to the ground, and even the contact of bedclothes is intolerable. A radiograph of the joints was negative.

He suffers from numbness of the arms on waking, frequent tremors, cramps at the backs of the knees, and a habit spasm of the arm when walking or driving. He is much addicted to talking in his sleep. Two years ago he suffered an attack of herpes in the scalp. He occasionally suffers from acne vulgaris on the back and shoulders.

In 1906, as a result of the first operation of litholapaxy, he developed an epileptiform attack, which recurred in two, three, or six months, and always happened during sleep. The interval lengthened until the attacks completely

disappeared some twelve years ago. Litholapaxy had been performed some eight times in all up to the time of admission.

EXTRACT FROM MEDICAL REPORT, JULY 11, 1922.

Examination of Fæces :—	
Undigested muscle fibres	Nil
Undigested fats	Nil
Fatty acids and soaps	Nil
Undigested starch	+
Ova and parasites	Nil
Occult blood	Nil
Crystals	Nil
Organisms on culture	A high proportion of streptococci and diphtheroids.
Examination of Blood :—	
Hæmoglobin	95 per cent
Total red cells	5,670,000 per c.mm.
Colour index	0·84
Total white cells	6,400 per c.mm.
Lymphocytes	35·0 per cent
Polymorphs	55·0 „
Eosinophils	1·0 „
Large mononuclears	7·0 „
Mast cells	1·0 „
Myelocytes	1·0 „
Total cells counted	200
Arneth index of polymorphs	1 2 3 4 5 / 5 34 40 19 2 per cent
Average per cell (normal : 2·76)	2·79
Iodophilia	Nil
Calcium index	Nil
Malarial parasites	Nil
Results of Urine Analysis :—	
Source	24 hours
Specific gravity	1012
Urea (normal 2·2 per cent)	0·8 per cent
Total acidity (normal urine = 2 c.c. N/1 NaOH per cent)	1·0 c.c. per cent
Albumin coagulable	Nii
Xanthoproteic reaction	Nil
Sugar—Benedict's test	Nil
Acetone and diacetic acid (Rothera's test)	Nil
Amino-acid derivatives :	
Tryptophane as Skatoxyl	Nil
„ „ Indican	+
„ „ Indirubin	Nil
„ „ Indol	Nil
Tyrosine „ Tyramine	+
Bile salts	Nil
Bile pigments	Nil
Phosphates on boiling / „ „ neutralization	Nil
Organisms	Streptococci and *B. coli*
Deposit on cooling	Slight
„ „ centrifuging	Pus cells and organisms. No cystin crystals were observed.

Family History.—Father, age 82, and mother, age 80, are still living, and enjoy reasonable health. They were not related before marriage.

One brother and two sisters suffered from similar kidney calculi: (1) One sister died after having one kidney opened some years ago. (2) A second sister had her right kidney removed about four years ago and has apparently had no further trouble, although she is in a state of chronic ill health. The kidney was enormously enlarged and adherent to stomach and bowels, and over two hundred cystin stones were found in it. (3) A brother two years senior has an abscess in one kidney and stones in the other.

The patient has three children, and states that the oldest girl has the same sediments in her urine as he has himself.

Patient was admitted to King's College Hospital in February, 1924. He felt there was a large stone in his bladder which he could not pass per urethram.

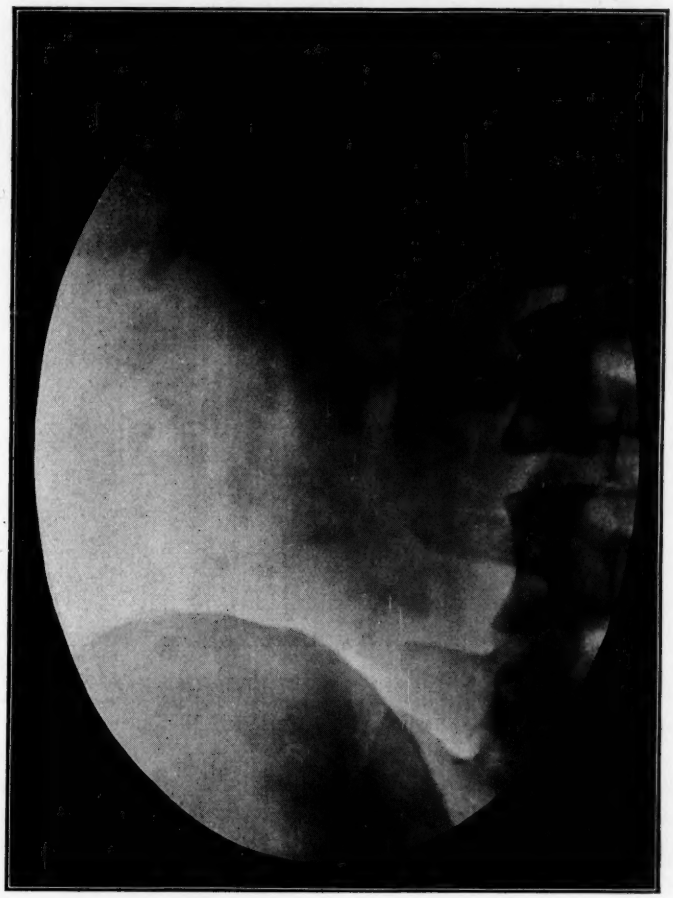


FIG. 264.—The radiograph shows a small collection of cystin stones in the lower pole of the left kidney.

He brought up a few of some dozen small stones which he had recently passed. They are small rough bodies, the size of a large pea, of yellow colour and waxy appearance. Analysis of one showed it to be entirely composed of cystin.

X rays showed a small collection of stones in the pelvis of the left kidney, with one low down in the ureter and two in the bladder—a large and small one (*Figs.* 264, 265).

The urine was pale yellow, and slightly turbid and oily. There was a slight yellow deposit. Reaction was alkaline. Much pus was present, and *Staphylococcus albus* and *Bacillus coli* were cultivated. No cystin crystals were found in the urine even after acidifying with acetic acid and acetone. The chemical reactions of cystin were absent.

The large stone was crushed by Sir John Thomson-Walker under stovaine, and shortly afterwards the small stone seen in the skiagram was passed. The patient left hospital the next day.

Repeated specimens of urine were sent up by the patient, but no cystin

FIG. 265.—One stone is shown in the bladder, another in or near the left ureteric orifice, and a third in the left ureter a short distance from the orifice.

was found on daily examination. On April 14, almost two months after litholapaxy, a specimen was received by post which contained cystin crystals in abundance. The specimen was different from those previously received. It was darker, more oily, and yielded a heavy deposit. It had a sweetish odour. Pus cells were abundant. On standing for a few days, the characteristic smell of hydrogen sulphide developed. Cadaverin and putrescin were looked for in this specimen by benzoylation, but I could detect none.

Specimens received from the parents contained no cystin. The urine of all three children was dark and yielded a heavy deposit. No cystin was found in either, but very characteristic tyrosin crystals were found in the urine of the youngest child, a girl of 4.

The patient lives some hundred miles away, and experimental work is impossible. As far as it has been exploited, the case seems to add little further to our present knowledge of the subject, beyond the fact that it definitely establishes a condition of intermittent cystinuria. Two years ago, a very thorough search for cystin in the urine was negative. For two months only one specimen was obtained in which it was found. All specimens were searched regularly without result until the specimen received on April 14 showed cystin in abundance. Two cases of temporary cystinuria have been previously recorded by Warburg, and Semon and Lewis.

The familial nature of the disorder is brought out strongly, particularly along horizontal lines, i.e., the brothers and sisters of the patient. The urine of the children is not above suspicion. Only one specimen from each child was examined, and although repeated attempts to find crystals bore no fruit, yet the urines were far from normal, and I think it highly probable that at some time or other cystin could be found. The discovery of tyrosin in the youngest child is hard to explain apart from cystinuria.

The gouty attacks lead one to think of Abderhalden's famous case of the infant who died of so-called 'inanition', and in whose tissues deposits of cystin

FIG. 266.—The print is of various urinary stones X-rayed simultaneously, to show their relative opacity. A, Oxalate. B, Phosphate. C, Collection of small cystin stones. D, Uric acid stone.

crystals were found. Although there is no definite evidence that the acute attacks of arthritis are in any way related to the error of metabolism, it seems reasonable to suspect an intra-articular deposit of cystin similar to the deposit of sodium biurate in gout.

The liability to skin disorders finds a parallel in the case described by Miller which displayed a 'stubborn urticaria'. Miller actually found cystin crystals in the blood.

The prodromal attacks of dyspepsia do not occasion much comment, but it is difficult to associate the attacks of blepharitis with the renal condition. In Tennant's case of a young woman, age 21, the only symptom beyond hæmaturia was that " her eyes filled with tears during urination ". Reflex lachrymation can be readily understood, and probably occurred in the case quoted, but there is nothing to explain the blepharitis.

There is a popular conception that cystin stones cast a poor shadow with X rays. As Morris pointed out some years ago, cystin calculus is second only in X-ray opacity to oxalate calculus. The accompanying photograph (*Fig.* 266) shows a comparison between urinary stones given the same exposure.

Treatment, as in all disorders of metabolism, is disappointing. Rationally, treatment should be directed towards arresting the excretion of cystin by the kidneys as a prophylactic against calculus formation. Diet has little effect. It has been shown that ingestion of cystin by mouth has no influence upon the output of cystin by the kidneys, although it increases the output of organic sulphates. Cystin is soluble in alkaline media; thus, by keeping the urine alkaline, cystin crystals should not be formed. Klemperer and Jacoby state that administration of 6 to 10 grm. of sodium bicarbonate causes complete cessation of cystinuria. In cases in which stones have already been formed, this treatment is of no avail.

Choleic acid may be given—a treatment based on the hypothesis that endogenous cystin should normally become the taurin of the bile salts, and that its excretion as cystin is due to lack of choleic acid with which it can conjugate.

In this case, as in many quoted, bowel sepsis determines the pelvic infection which furnishes the irreversible colloid that glues the crystals into calculi. An attempt should be made, therefore, to allay fermentation in the bowel by intestinal antiseptics, such as salol and kerol, coupled with urinary antiseptics. A course of vaccines may be tried. In the case described, a vaccine was prepared from the fæcal strains enumerated above, the dose rising from 0·1 c.c. to a maximum of 1·0 c.c., at intervals of from five to seven days. This treatment gave rise to an eczema which persisted throughout the course, and seemed to have little effect upon the condition.

The question of operative measures must receive consideration. The risks of nephrectomy in this case would, I think, be unjustifiable. Removal of the stones by nephrotomy would be useless. The infection of the pelvis would again determine the formation of new stones. Southam, however, states that cystinuria may cease with operation, and quotes a case which remained free from cystin for fourteen years after operation.

The case described is being treated with kerol and urinary antiseptics, and stones too large to be passed per urethram are dispersed by crushing as they arise.

I wish to thank Sir John Thomson-Walker for permission to investigate and publish this case, and Mr. C. P. G. Wakeley for his advice.

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RETROPERITONEAL CATHETERIZATION OF THE URETERS.

By ANDREW FULLERTON, Belfast.

It occasionally happens that for some reason it is impossible to catheterize the ureters by the ordinary method. The bladder may be so extensively ulcerated, or so irritable, that enough fluid cannot be retained; or the medium may be so clouded by blood, pus, mucus, débris, etc., that the ureteral orifices cannot be seen. The ureter, or its orifice, may be stenosed, displaced, or distorted by some local condition, as, for example, a tumour inside or outside the bladder. A fold, or some unusual conformation of the intramural portion of the ureter, or spasm, may prevent the passage of the catheter. A large endovesical prostate, or other projecting tumour, may also give rise to insuperable difficulties by placing the ureteral orifices out of view or out of reach. The operation about to be described was designed with the object of surmounting any of these difficulties.

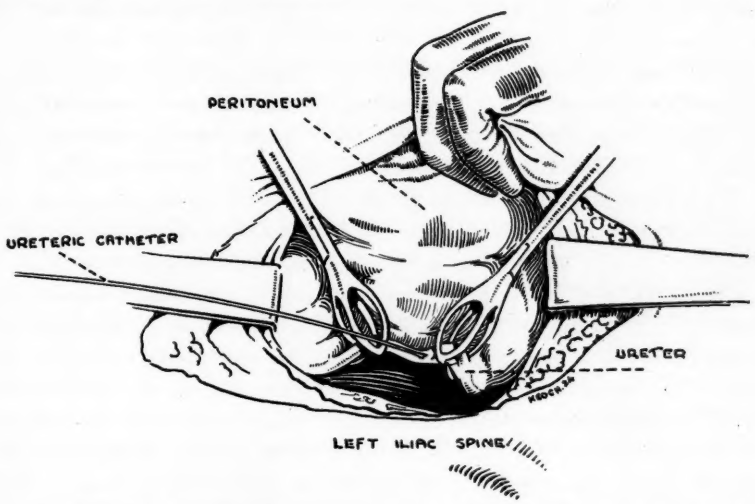

Fig. 267.—Showing peritoneum carrying ureter stripped back from pelvic wall. The ureter is shown fixed between two points by Lane's tissue forceps. The introduction of a ureteral catheter is shown. The segment of ureter between the forceps should be taut, and the ureter should be shown less curved on the right side of the figure. The catheter is entering a small slit in the longitudinal axis of the ureter.

An incision about 4 in. long is made in the lower iliac region, and the external oblique aponeurosis split in the direction of its fibres. After retraction, the internal oblique and transversalis muscles are similarly split in the direction of their fibres. The edges of the wound are now widely retracted, and the peritoneum is stripped from the iliac fossa and the lateral wall of the pelvis until the external iliac artery is reached. It will be found that the ureter has been reflected with the peritoneum, and can be recognized on its deep

surface as a thin strap, accompanied by longitudinal vessels. A section, about 2 in. long, of the ureter is steadied by two pairs of Lane's tissue forceps, each of which surrounds the ureter without damaging it. By traction on these forceps the required area of the ureter can be made taut, and brought, with the adherent peritoneum, towards the surface of the wound. A short longitudinal incision is made into the lumen, and a catheter introduced towards the renal pelvis (*Fig.* 267). This is done on both sides, and specimens are obtained from both kidneys. When sufficient urine has been collected, the small slit is accurately closed by a double layer of fine continuous catgut suture, excluding the mucous membrane. A small glove-drain is introduced, and the wound closed in the usual way.

This procedure was carried out in the following case, that of a male, age 45. About two years previous to my examination he began, rather suddenly, to suffer from frequency of micturition. This had continued ever since, and was accompanied by the passage of 'blood and corruption' in the urine. If he held his urine too long he had pain in the penis. During the night, if he fell asleep, he might retain for a maximum of two hours, but as a rule he was obliged to micturate every ten minutes, day and night. I examined him on Aug. 27, 1923. He appeared to be a strong, healthy man. Nothing could be made out on abdominal examination. Per rectum, he complained of pain on pressure over the base of the bladder. Nothing abnormal could be detected in the prostate or testes.

The urine was cloudy, alkaline, sp. gr. 1010, contained phosphates, pus, some blood-cells on microscopic examination, and a small amount of albumin. Sugar was absent. A few clumps of bacilli resembling tubercle bacilli were found in the urine, but the bacteriologist was not quite satisfied as to their identity. The bladder held, with great difficulty, about 2 oz. of fluid, and the patient strained and struggled so much that cystoscopy was almost impossible. The right side of the bladder appeared fairly normal. On the left side there was a good deal of redness, and the orifice of the left ureter was obscured by a small cystic swelling. There was a good deal of bleeding from the region of the neck of the bladder, which prevented a satisfactory examination. Attempts were made to catheterize the ureters, but although the points of the catheter engaged the orifices, they could not be passed farther. About a fortnight later, further attempts were made, after the injection of indigo-carmine subcutaneously and under an anæsthetic, but again without success. The ureters were then exposed in the iliac regions. The left side was first dealt with, and then the right. Both ureters were dilated and their walls were much thicker than normal. I attributed this to back pressure from compression of the intramural portion of the ureters by overaction of the bladder muscle. A small slit was made into each ureter, so as to admit a ureteral catheter, and specimens were easily obtained. On conclusion of the observation the openings were accurately sutured with fine catgut on a round needle, and the wounds in the parietes closed. Healing took place by first intention.

The specimen from the right side was slightly cloudy, with a blue tinge, was neutral in reaction, had a specific gravity of 1010, and contained a small amount of pus and a trace of albumin. An odd red cell and some ureteral epithelial cells were seen on microscopical examination. The chloride output

was 0·3 per cent and the urea 1·4 per cent. Staphylococci were found in pure culture. The specimen from the left side was clear, with a pale-blue tinge, acid in reaction, had a specific gravity of 1020, and was free from pus and albumin. A few red cells and some ureteral epithelial cells were seen on microscopical examination. The chloride output was 1·1 per cent, and the urea 1·9 per cent. Staphylococci were absent.

An autogenous vaccine was given, and the bladder irrigated daily with weak nitrate of silver solution. The frequency soon diminished, so that the patient could retain for one to one and a half hours. He was then sent home, supplied with the vaccine, which was administered by his medical attendant. A letter from the latter, dated April 5, 1924, states that " the patient is very well. For days together he has no trouble in the bladder. Micturition is generally normal. He eats well, sleeps well, and has put on some flesh." I believe that, when the over-action of his bladder has passed off, the obstruction at the entrance of the ureters will disappear.

In this case one would have been justified in suspecting the left kidney from the cystoscopic appearances, and the condition of the left ureter when exposed would have confirmed these suspicions had not the right ureter also been examined. It is probable that, if the bladder had been opened, attempts to catheterize the ureter by this route would have failed on account of the obstruction, which was sufficient to cause dilatation and what appeared to be hypertrophy of the walls of both ureters.

A recent paper by N. P. Rathburn[1] will tend to revive interest in a method which most of us who practise urology have used on occasions. The author of this paper recommends suprapubic cystotomy and catheterization of the ureters through the open bladder for certain cases of tuberculosis in which it is impossible to catheterize the ureters in the usual way on account of limited capacity and inability to wash the field free of blood, pus, and tenacious mucus. He quotes Marion, Carlier, and Pasquereau in support of this procedure, and Cathelin as mentioning it only to condemn it. The last-mentioned author recommends, as an alternative, one of three measures, (1) the segregator, (2) lumbar incision with aspiration of urine from the kidney pelvis, and (3) temporary ligature of the ureter on the supposed diseased side through a groin incision and collection of urine through the bladder from the supposed healthy side.

Speaking of the attendant risk of cystotomy, Rathburn points out that cystoscopy may be, and often is, attended by quite as much shock and discomfort, and is not entirely devoid of risk, and, furthermore, does not always accomplish its aim. With this expression of opinion most surgeons will be in thorough agreement. The risk of a suprapubic fistula which fails to heal is also mentioned.

In a recent case of extensive ulceration of the bladder, I failed to find the ureteric orifices even after wide exposure by cystotomy, and resorted to the expedient of stripping back the peritoneum from the bladder till the ureters could be felt and traced to their junction with the latter The position of the vesical ends of the ureters being thus located, we succeeded in introducing the catheter through the open bladder. Tuberculosis of the kidney being excluded by examination of the specimens thus obtained, as much as possible of the ulcerated surface of the bladder was cut away with scissors, with the

result that the patient was completely cured of intolerable suffering which had lasted for several years. In this case it would, perhaps, have been easier and safer to have performed the retroperitoneal exposure of the ureters just described.

CONCLUSIONS.

1. It may be impossible to catheterize the ureters by the ordinary method.

2. The ureter can be exposed for catheterization by stripping inwards the peritoneum after an incision in the parietes similar to that used for appendicectomy.

3. In tuberculosis of the kidney, if a thickened ureter be found on one side, it need not be further disturbed. All that is necessary is to obtain a specimen from the opposite ureter.

4. With careful technique and accurate suturing there need be no extravasation of urine.

5. The actual quantity of urine secreted by a kidney can be ascertained: (*a*) By using a catheter of sufficient calibre to fit the ureter snugly; or (*b*) By compressing the ureter round the catheter so as to avoid leakage by the side of the latter.

6. The specimens so obtained are free from any contamination from the bladder contents.

I am greatly indebted to Mr. C. A. Keogh, my resident pupil, for the accompanying drawing.

REFERENCE.

[1] RATHBURN, N. P., *Surg. Gynecol. and Obst.*, 1924, xxxviii, No. 3.

FIBROMA OF THE ABDOMINAL WALL.

By M. J. STEWART, Leeds, and T. B. MOUAT, Sheffield.

SUMMARY.

I.—Introduction.
II.—Historical Summary.
III.—Report of Seven Personally Observed Cases.
IV.—Tabular Summary of a Recent Series of 66 Cases.
V.—Clinical and Pathological Aspects.
1. Etiology.
2. Morbid anatomy and histology.
3. Signs and symptoms.
4. Diagnosis.
5. Course and prognosis.
6. Treatment and results.
VI.—Summary and Conclusions.

I. INTRODUCTION.

Fibroma of the abdominal wall, or desmoid tumour, is a condition which has had a considerable amount of attention paid to it at various times during the last sixty-five years, and the main facts of its natural history are now well established. Of somewhat infrequent occurrence, it is nevertheless a clinical entity of great general interest and some importance, and does not merit the comparative neglect into which it seems to have fallen of late in this country. In structure a true fibroma, it owes its clinical and pathological interest mainly to its site and to the fact that about 80 per cent of the cases occur in women who have borne children.

By the kindness of Sir John Bland-Sutton, Mr. Victor Bonney, and Mr. Giles, of the Chelsea Hospital for Women, and of Professor Hellier, Mr. L. R. Braithwaite, and Mr. William Gough, of Leeds, we have had the opportunity of studying seven cases of this disease. For this reason, and also as it is now twenty years since the publication of Pfeiffer's comprehensive monograph, we have thought it worth while to review the subject afresh, and to collect as far as possible all the recently reported cases. We have also included in our analysis eighteen cases from the older literature not given by Pfeiffer, making, with our own seven, a total of sixty-six. Only cases in which a reasonable amount of detail is given have been included.

II. HISTORICAL SUMMARY.

Labbé and Remy, in their monograph published in 1888, divide the history of abdominal-wall fibromas into two periods, a ten-year period prior to 1860, during which nine isolated cases were reported by various observers, and

the period from 1860 onwards, when the condition was recognized as a definite entity, and various series of collected cases were published. Of the nine cases in the first period, two occurred in France, one in Belgium, four in Germany, and one each in Sweden and in England. The first four were reported in 1850, those of Sappey (1850) and of Limauge (1850) being exceptional in that the tumours occurred in men, while those recorded by Langenbeck (1850) were in women who had borne children. An early report of two cases by Macfarlane of Glasgow (1832) was evidently unknown to Labbé and Remy. There can be little doubt from the details given that these were examples of fibroma of the abdominal wall, although the first is described under the title, " organized sarcomatous tumour between the layers of the abdominal muscles ", and the other as a " fibrocartilaginous tumour " in the same situation.

The fibrous nature and benign character of these tumours were recognized from the outset, although there was much controversy as to their point of origin, and, to a less extent, as to the mode of treatment. Bouchacourt (1851) was the first to show the diagnostic importance of immobilization of the tumour when the abdominal muscles were thrown into action, while Santesson (1855) noted the liability to sudden increase in size at a given moment. Paget's (1856) case is important as showing the possibility of traumatic origin.

In 1860 an important discussion, initiated by Huguier, took place at the Société de Chirurgie. Huguier (1860), who had seen four cases, recognized that he was dealing with a distinct entity, and, while he correctly stated the fibrous nature of the growth, was responsible for an anatomical error which continued to colour French surgical practice for the next fifteen years. This was that the tumour was invariably attached by a pedicle to the pelvis, from the periosteum of which Huguier supposed that it took origin. He suggested section of the pedicle as a method of treatment. Earlier observers had practised excision, and in the discussion at the Société de Chirurgie Verneuil expressed the view that the tumour should be excised if not adherent to the peritoneum. Huguier's cases and those of Gosselin and Gubler formed the basis of a thesis by Bodin (1861), who called them peri-pelvic fibrous tumours. In the following year Nélaton (1862) published a clinical lecture on the subject, but changed the name from intra- and extra-pelvic tumours to tumours of the iliac fossa and iliac crest. He recognized the close connection with pregnancy and parturition, but accepted the pelvic periosteal theory of their origin. He advocated treatment by excision, but thought that small tumours might be dealt with by section of the pedicle.

While French surgeons were thus going off on a side track, observers in other countries (Cornils 1865, Buntzen 1868, Boye 1873, etc.) were referring neither to a pedicle nor to an osseous origin, a musculo-aponeurotic origin and treatment by excision being equally accepted. In France it was not until 1875 that Guyon (1875) put right the error initiated by Huguier. In the same year Suadicani (1875) made the great advance of applying Listerian antiseptic methods to the extirpation of these tumours. Prior to that time operators had the possibility of peritonitis always before them, especially in cases where the tumour was adherent to the peritoneum; afterwards, radical measures could be adopted with almost complete safety.

The earlier observers had spoken of this tumour as a fibroma or fibroid,

or as a fibrous or fibroplastic tumour. Sänger (1884) first applied the term desmoid, originally used by Johannes Müller (1838) to designate tumours of tendon-like consistency. It is interesting to note that while French authors have continued to use the term 'fibrome de la paroi abdominale', most German and many British and American writers have followed Sänger in using the term 'desmoid'. The French usage has led to greater precision, inasmuch as the term has been strictly confined to true fibromas, whereas desmoid has sometimes been used to include definitely malignant (fibro-sarcomatous) tumours. Sänger was responsible for an important operative innovation. He advised resection of the peritoneum in cases where this membrane was adhered to the growth, rather than decortication, which had been the method previously in vogue.

III. REPORT OF SEVEN PERSONALLY OBSERVED CASES.

Case 1.—G. F., age 26, was admitted to the Chelsea Hospital for Women under Mr. Victor Bonney on Sept. 26, 1911. She had borne one child a year and eleven months before, and had had an easy and non-instrumental labour. There was no history of trauma or of any undue abdominal strain, and she looked robust. About eight months before admission she accidentally discovered a lump in the abdominal wall immediately above and to the right of the umbilicus. It gave rise to no symptoms, but felt " like a hardness in the muscle about the size of a penny ".

On admission the tumour was the size of the closed fist, and it appeared to be in the substance of the right rectus muscle.

At operation this was confirmed, and it was further found that the growth was adherent to both anterior and posterior rectus sheaths, and to the peritoneum, while the muscle fibres above and below seemed to disappear into its substance. The tumour was freely excised, together with portions of the rectus sheath and peritoneum. There was free hæmorrhage, and the large gap in the abdominal wall was closed with difficulty with strong silk mattress sutures. Union was satisfactory, and five months later the patient was in good health, free from any sign of recurrence.

Case 2.—B. M., age 34, was an in-patient of the Chelsea Hospital for Women under Mr. Giles from July 7 to 28, 1911. She had four children aged respectively 6, 4, and 3 years, and 16 months. There had been a miscarriage eight years before. The first three labours were severe and rather prolonged, the first being instrumental, while the fourth was easy. She had severe abdominal pain after the last confinement, and presently noticed a lump in the lower part of the abdomen. She got up at the usual time after delivery, and han no further trouble until shortly before admission to hospital, when she sought medical advice on account of increased loss of blood at the menstrual periods.

On admission the patient was strong and healthy-looking, and abdominal examination revealed an ill-defined tumour above and to the left of the symphysis pubis. The uterus was bulky, and bimanual examination seemed to show that the hypogastric tumour was connected with it. A diagnosis of subserous fibroid was therefore made.

At operation a median suprapubic incision was made, when the entire tumour was found to be embedded in the lower end of the left rectus muscle. All the deeper and outer muscle fibres seemed to terminate abruptly in the growth, and it had to be cut freely out of the muscular substance. It was also adherent to the peritoneum, which was opened in removing it. The gap was drawn together with strong silk mattress sutures and the wound healed satisfactorily. Seven months later the patient was in perfect health and without any signs of recurrence.

Case 3.—E. G., age 35, was an in-patient of the Chelsea Hospital for Women under Mr. Bland-Sutton from Feb. 26 to March 20, 1900. Her first confinement,

Jan. 1890, had been non-instrumental and easy, her second, April 1895, very difficult and prolonged, and her third, two years and a half later, also difficult. She stated that her second confinement left her with a feeling of weakness in the right inguinal region, which became more marked and was accompanied by pain in the same situation during the latter half of her third pregnancy. The presence of a tumour was first noticed about six months after delivery, and at the time of admission to hospital it had reached the size of a large orange.

AT OPERATION the tumour was found to be firmly embedded in the substance of the abdominal wall, and to be adherent posteriorly to the fascia of the internal oblique. It was excised without opening or injuring the peritoneum, although a number of small portions had to be taken away separately after removal of the main mass. The wound was closed with strong silk, and recovery was uneventful and union satisfactory. Eleven years later the patient reported herself as well and with no sign of recurrence.

Case 4.—E. B. S., age 24, was an in-patient of the Chelsea Hospital for Women under Mr. Bland-Sutton from March 13 to 27, 1903. She had two children, the youngest a month old. Fourteen months before admission she had first noticed a lump, the size of a walnut, in the right iliac region. It was painless, and grew slowly, but at the time of the birth of her second child there was a rapid increase in size.

ON ADMISSION the tumour had attained the size of a very large orange. It was of firm consistence, painless, slightly movable, and seemed to be situated in the substance of the abdominal wall. There was no adhesion to the skin.

AT OPERATION the tumour was found to be firmly adherent to the musculo-aponeurotic structures of the abdominal wall. It was found possible to strip off the peritoneum without injury. Recovery was interrupted, but the after-history could not be obtained.

Case 5.—E. S., age 40, was admitted to the Hospital for Women and Children, Leeds, under Mr. William Gough, Oct. 22, 1921. She had had a stillborn full-time child eighteen months previously. Six months before admission she accidentally discovered a lump in the left side of the abdomen, just above the middle of Poupart's ligament. It had not appreciably increased in size since that time, but had given

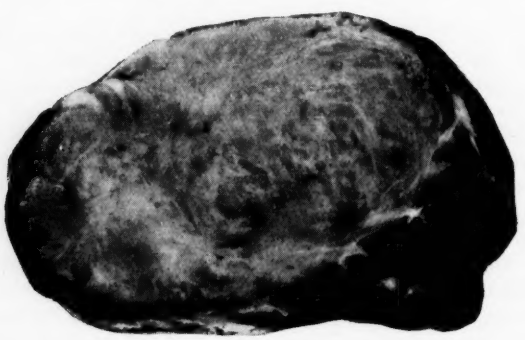

FIG. 268.—Fibroma of abdominal wall, on section, natural size. *Case* 5 in this series. The fibrous character of the growth and the lack of definition at the margins are shown.

rise to neuralgia of moderate intensity. Her general health had always been good, and she had had but the one pregnancy. There had been no menstrual irregularities. On examination a densely hard oval mass about the size of a hen's egg was found, lying obliquely about 2 in. above the inner end of Poupart's ligament. It was fairly movable, but immediately became fixed when the patient was caused to contract her abdominal muscles. The inguinal canal seemed to be free, and vaginal examination revealed nothing abnormal.

At operation an incision 2½ in. long was made over the centre of the tumour in the line of the internal oblique muscle. The several layers of the abdominal wall were divided, and the tumour was then found to lie in the muscular tissue of the internal oblique and transversalis muscles, under cover of and attached by a broad pedicle to the conjoined tendon at its lower end. A fair margin of muscle was excised with the tumour, which was free and encapsuled on its anterior aspect, but firmly adherent to muscle behind and at the margins. This adhesion was particularly noticeable at the upper and outer and lower and inner poles of the growth, which seemed to merge completely with the surrounding muscle. The peritoneum was not involved. After removal of the growth, the muscular and fascial structures were brought together, and, more particularly, the conjoined tendon was stitched down to Poupart's ligament, as in Bassini's operation. The wound healed without difficulty and the patient was discharged 'well'. She was seen two years and six months later, and found to be in excellent health and free from any sign of recurrence. She was still subject to local attacks of pain.

The tumour on section (*Fig.* 268) was found to consist of whorls and strands of dense fibrous tissue, and at the poles the fusion with surrounding muscle was well seen. The colour was rather pinker than that of an ordinary fibroma.

Case 6.—G. M., age 23, was admitted to the General Infirmary, Leeds, under Mr. L. R. Braithwaite, Feb., 1922. She was unmarried and had borne no children. For four years there had been a steadily growing tumour in the left iliac region, which, at the time of admission, extended from the costal margin to below the anterior inferior spine of the ilium. She had been in hospital in Sept. 1921 and had had a portion of the growth removed. Microscopically it had the characters of a fibroma. Slight pain had been constantly present, with occasional exacerbations. The general health had been good and menstruation normal. At the time of her second admission the tumour had reached the size of the fœtal head, and was apparently adherent above to the tips of the 11th and 12th ribs, and below to the crest of the ilium. There was practically no mobility.

At operation, Feb. 9, a curvilinear incision was made round the edge of the tumour, which was found to be infiltrating the gluteal muscles below. On its deep aspect, the growth was in contact with peritoneum, from which, however, it was readily stripped. The tumour was excised, together with a margin of infiltrated muscle, the tips of the 11th and 12th ribs, and a portion of the crest of the ilium. A very large cavity remained, which was partially closed by approximating the internal oblique to the iliacus, and the transversalis to the quadratus lumborum. A drainage tube was then inserted. Healing was long in taking place, as the large gap had to granulate up from the bottom. When the patient was seen six months later the wound was completely healed, but a large and unsightly scar remained. Two years and two months after operation she was in good health and free from recurrence, and she had recently married.

Case 7.—This is an example of a fibroma arising in the scar of a former abdominal operation wound. The patient, A. S., age 31, was admitted to the General Infirmary, Leeds, under Dr. Hellier, July 24, 1913. She was married, and had borne one child. In Oct., 1911, she had had an operation for ovarian cyst, complicated by gangrenous appendicitis with peritonitis, and soon afterwards she noticed a hard lump beneath the upper part of the scar. This was fixed to the skin but was not tender on pressure, though there was some discomfort when the clothes pressed on it.

At operation a solid tumour the size of a pigeon's egg was removed from the abdominal wall. It lay between the recti muscles at the level of the umbilical region and involved both muscles as well as the peritoneum. Elsewhere it appeared to be encapsulated. The peritoneum was opened during the course of the operation. The patient made an uninterrupted recovery, and when seen eleven years later was in excellent health and free from recurrence. For some time after operation there had been slight weakness and bulging of the scar, but this improved greatly during the war,' when she served as a post-woman for three years. She now has a child 3 years old, both pregnancy and parturition having been uneventful.

IV.—TABULAR SUMMARY OF A

Case No.	Year of Publication	Author	Sex	Age	Duration in Years	Preg-nancies	Trauma or Scar
1	1832	Macfarlane 1 ..	M.	22	2		Severe exertion
2	,,	,, 2	F.	26	3	0	Trauma ..
3	1880	Allen	M.	56	6		
4	1882	Briddon	F.	27		3	
5	,,	Wallace	F.	34	2–3	5	
6	1885	Jouon	F.	45	$\frac{6}{12}$		Trauma ..
7	1888	Reed 1	F.	33		4	Trauma ..
8	,,	,, 2	F.	34			
9	,,	,, 3	F.	19	3		Trauma ..
10	,,	,, 4	F.	25		2	
11	,,	,, 5	F.	32		0	
12	1894	Chretien	F.	31	$1\frac{9}{12}$	2	
13	1895	Fieux	F.	25	$\frac{4}{12}$	3	
14	1903	Abadie	F.	30	$\frac{10}{12}$	4	
15	,,	Fredet 1	F.	31	$\frac{3}{12}$	3	
16	,,	,, 2	F.	24	$2\frac{6}{12}$	3	
17	,,	Silberberg	F.	23	$\frac{10}{12}$	3	
18	,,	Vernot	F.	21		2	Slight trauma ..
19	1905	Powers 1	F.	25–30		1	
20	,,	,, 2	F.	25–30		1	
21	,,	,, 3	F.	25–30		1	
22	,,	Cullen	F.	30	3		
23	,,	Eitel	F.	26	$\frac{10}{12}$		
24	,,	Gross and Sencert ..	F.	73	10		
25	,,	Montgomery ..	F.	30			
26	1906	Bidwell 1.. ..	F.	36	$1\frac{6}{12}$	1	
27	,,	,, 2.. ..	F.	33	$\frac{9}{12}$	7	

RECENT SERIES OF 66 CASES.

Position					Size	Result
Relation to Muscle		Relation to Umbilicus				
Recti	*Obliques, etc.*	*At*	*Above*	*Below*		
	+			+	Fist ..	Good recovery
	+	+			Fist ..	Death from peritonitis 4th day
+			+		2½ in. diam.	Healed well
	+			+	9 in. × 5 in., wt. 2½ lb.	
+				+	Cocoanut ..	Discharged well
					Very large ..	No recurrence in 1 year
	+	+			Large ..	Practically disappeared spontaneously
					Small orange	
+			+		5 cm. diam.	Good recovery
	+			+	23 × 13 c.m.	Death from peritonitis
					45 cm. circ.	Shrinkage of tumour after electrolysis
	+			+	Small orange	Discharged well in 20 days
	+			+	2 fists, wt. 380 grm.	Discharged well in a few days
	+			+	Fist ..	
+				+	Small nut ..	
	+			+	Turkey's egg	
	+			+	Large orange	
	+			+		
+		+			Pullet's egg	1 case only traced: well after 1 year
+		+			Small orange	
+		+			Baby's fist	
	+		+		13 × 7 cm.	
	+			+	Fist ..	
+				+	Very large ..	
					Very large ..	
	+			+	Lemon ..	No recurrence in 10 years
+			+		Small pear	Normal labour 8 months later

Continued on next page

IV.—TABULAR SUMMARY OF A RECENT SERIES

Case No.	Year of Publication	Author	Sex	Age	Duration in Years	Pregnancies	Trauma or Scar	Relation of Recti
28	1906	Eccles 1	F.	37	$\frac{6}{12}$	2		+
29	,,	,, 2	F.	26	1			
30	,,	,, 3	F.	35	$\frac{6}{12}$	3		
31	,,	Firth	F.	29	$\frac{4}{12}$	3	Muscular strain	
32	,,	Schwarzschild 1 ..	F.	28	2	+		
33	,,	,, 2 ..	F.	30		2		+
34	,,	Siegal and Delval ..	F.	27	$\frac{7}{12}$	1		
35	1909	Krusen	F.	29	1	4		+
36	,,	Pfannenstiel ..	F.	61			Trauma	+
37	,,	Stone 1	F.	56	20	1		
38	,,	,, 2	F.	23	$\frac{6}{12}$	+		+
39	,,	,, 3	F.	35	Short	+		+
40	,,	,, 4	F.	18	Short	+		+
41	,,	,, 5	F.	23	$\frac{7}{12}$	1		+
42	1910	Lockwood 1 ..	F.	15	2			+
43	,,	,, 2 ..	F.	25				
44	,,	,, 3 ..	F.	24				
45	,,	,, 4 ..	F.	30				
46	,,	,, 5 ..	M.	32	14			+
47	,,	Morison & Drummond 1	F.	36		2		+
48	,,	2	F.	28		2		+
49	,,	3	F.	35		3		+
50	,,	4	F.	25		2		+
51	,,	5	F.	30		2		+
52	1911	Senlecq & Chenot ..	F.	24	$1\frac{4}{12}$	+		+
53	1915	Greig	F.	$1\frac{8}{12}$	1	0		+
54	1916	Balfour 1.. ..	F.	44	14		Scar	

ERIES OF 66 CASES—*continued.*

Position					Size	Result
Relation to Muscle		Relation to Umbilicus				
Recti	*Obliques, etc.*	*At*	*Above*	*Below*		
+		+				No recurrence in 18 months
	+			+		Well 2 months after operation
	+			+		
	+			+	5 × 3 × 3 in.	No recurrence in 12 months
	+			+	Child's head	No recurrence in 12 months
+				+	Hen's egg	
	+			+	Large fist ..	Went home well
+				+	8 × 6 cm.	
+				+	Fist	
						Excised 20 years ago. Slow recurrence
+						
+			+			
+				+		
+		+			8 × 5 cm.	
+				+		
	+			+		
	+			+		
	+		+			Recurred. Re-excised 1 yr. 10 months later
+				+		
+			+			Well after 5 years
+				+		
+				+		
+			+			Recurred. Well 2 years after second removal
+				+		
+				+		Recurred in 2 years; re-excised
+			+		1 in. diam.	

Continued on next page

IV.—TABULAR SUMMARY OF A RECENT SER

Case No.	Year of Publication	Author	Sex	Age	Duration in Years	Pregnancies	Trauma or Scar
55	1916	Balfour 2 ..	M.	44	$\frac{9}{12}$		Scar ..
56	1918	Bevan	F.	30	$6\frac{8}{12}$	+	
57	1919	Danforth	F.	24	6	0	Scar ..
58	1922	Cahn	F.	24		0	Scar ..
59	,,	Delbet	M.	41	17		Trauma
60	1924	Stewart & Mouat 1	F.	26	$\frac{8}{12}$	1	
61	,,	,, ,, 2	F.	34	8	5	
62	,,	,, ,, 3	F.	35	2	3	
63	,,	,, ,, 4	F.	24	$1\frac{2}{12}$	2	
64	,,	,, ,, 5	F.	40	$\frac{6}{12}$	1	
65	,,	.. ,, 6	F.	23	4	0	
66		 7	F.	31	$1\frac{6}{12}$	1	Scar ..

V. CLINICAL AND PATHOLOGICAL ASPECTS.

1. ETIOLOGY.

The chief points which require discussion under this head are pregnancy, trauma, and operation scars.

The close connection which exists between pregnancy and fibroma of the abdominal wall has already been referred to. In Pfeiffer's (1904) series of 400 cases 87·1 per cent were women, and in the 265 female cases where the facts are given, 250 or 94·3 per cent had borne children. In our series of 66

Table I.—Age Incidence (61 Cases).

Age	Female	Male
0–10	1	0
11–20	3	0
21–30	33	1
31–40	16	1
41–50	1	1
Over 50	3	1

Pfeiffer's figures are as follows:—

15–25	41	Males commonest from 35–50.
25–35	146	
35–50	35	
Over 50	15	

SERIES OF 66 CASES—*continued.*

Position					Size	Result
Relation to Muscle		Relation to Umbilicus				
Recti	*Obliques, etc.*	*At*	*Above*	*Below*		
+		+			2 in. diam.	"Complete recovery"
					2 cm. diam.	
					Hen's egg	Recovery
	+			+	Fist ..	
+			+		Closed fist	No recurrence in 5 months
+				+	1½ × 2in. ..	No recurrence in 7 months
	+			+	Large orange	No recurrence in 1 yr. 9 months
	+			+	Very large orange	
	+			+	Hen's egg ..	No recurrence in 2 yrs. 6 months
	+	+			Fœtal head	No recurrence in 2 yrs. 6 months
					Pigeon's egg	No recurrence in 11 years

cases, the tumour arose in the scar of an old abdominal operation wound in 5. Of the remaining 61, 56 were adult females, 4 adult males, and 1 was a female infant; that is, 93 per cent of the cases were females. The occurrence or non-occurrence of pregnancy is mentioned in 45 of the adult female cases, and of these 40 had borne one or more children—89 per cent. If to this group of 45 cases the infant and the 4 male cases be added, it remains true to say that in 80 per cent of the cases in this series the tumour occurred in women who had borne children. The age incidence shows a corresponding restriction, the tumour being most frequently met with in the third and fourth decades.

In our series 7 cases gave a history of a blow or other injury to the affected part at some period antecedent to the appearance of the tumour. Two others gave a history of severe muscular strain or exertion.

Fibroma of the abdominal wall is of comparatively infrequent occurrence. Most surgeons see only a handful of cases even in the course of a long professional career. Labbé (1888) saw 10 cases in twenty years, Billroth (1888) 16 in twenty-three years, and Nélaton (1862) 15 or 20 in twenty-six years. At the Mayo Clinic (Nichols, 1923) 25 cases were seen in the sixteen years 1906–1922. The largest published series from one source is Pfeiffer's (1904), 40 cases from von Bruns' clinic at Tübingen, seen during a period of forty-six years. It is obvious, therefore, that this tumour is one of the rarer accidents of pregnancy, and the connection between the two has given rise to much speculation. Nélaton (1862) was the first to point out that pregnancy was an

almost invariable antecedent. He attributed importance to the congestion of parts about the pelvis during menstruation and following conception, but believed that the tumour took origin from the fibrous periosteum of the pelvis. Following on the general acceptance of the musculo-aponeurotic origin of these tumours, Ebner (1880) and Herzog (1883) advanced the theory that they resulted from muscular rupture, either in consequence of a violent effort or from traumatism. This, however, failed to explain the age and sex incidence, and it remained for Labbé and Remy (1888) to suggest that muscular rupture during the violent contractions of labour was the real explanation. They drew comparisons with the formation of exuberant callus in bony fractures, and with keloid. Ordinary trauma or violent muscular contraction apart from labour would account for cases in males or in women who have not borne children, and indeed a history of such injury is often given. Sänger (1884) did not accept the view of a muscular origin, and thought the tumour arose from the aponeurotic sheath. He was therefore opposed to Herzog's traumatic theory. Pfeiffer (1904) accepted Labbé and Remy's theory, and pointed out that Wischnewsky had shown that in pregnancy there is hypertrophy of the abdominal muscles coincident with the hypertrophy of the uterus, and strikingly different from the atrophy of the abdominal musculature met with in states of pathological distention such as ascites or ovarian cyst. He considered that Ribbert's theory was applicable to these cases. Aimé Guinard (1910) thought that fibromas of the abdominal wall originated in the intra-parietal portion of the round ligament in the great majority of cases, and explained the sex distribution in this way. He doubted the importance of pregnancy, as he had met with three cases in young girls who had never borne children. He had also noted the presence of unstriped muscle fibres in many of the tumours which he had examined, and thought that they occurred almost invariably in the ilio-inguinal regions. He admitted, however, that some might be of aponeurotic origin, while those occurring in males he believed to be aponeurotic fibrosarcoma.

The occurrence of fibromata in operation scars in the abdominal wall is well recognized, but quite infrequent. *Case* 7 in our own series is an example of this kind, the tumour making its appearance in the scar two years after laparotomy for ovarian cyst with gangrenous appendicitis and peritonitis. In our collected series of 66 cases there are 4 other instances, all following laparotomy, 2 from the Mayo Clinic reported by Donald C. Balfour (1916), and 1 each reported by Danforth (1919) and by Cahn (1923). Wyllys Andrews (1911) mentions two cases in which the tumour appeared in herniotomy scars.

For ourselves, we find the traumatic theory of the origin of these growths an attractive one, and especially do we agree with the views expressed by Labbé and Remy on the importance of the part played by the physiological trauma of labour. Fibroma of the abdominal wall is undoubtedly of musculo-aponeurotic origin, at any rate in the vast majority of reported cases, and the round-ligament hypothesis of A. Guinard is quite untenable. The anatomical position excludes the possibility of such an origin in many cases, and the unstriped muscle fibres described by this author are in all probability included striped muscle fibres which have undergone the peculiar metamorphosis to be described in the next sub-section. The analogy with keloid is

a very close one. The naked-eye and microscopic characters are almost identical, at least so far as the actual tumour tissue is concerned, the points of difference being really dependent on their site in the skin and muscle respectively. Keloid tends to be the more sharply circumscribed, and it lacks the characteristic muscular inclusions of the other. The element of individual predisposition clearly enters into both, since only a very small proportion of scars become keloidic, and only a very small number of parturient women develop fibroma of the abdominal wall.

2. MORBID ANATOMY AND HISTOLOGY,

1. **Number.**—Fibroma of the abdominal wall is almost invariably single. In Labbé and Remy's collected series of 100 cases there were 3 in which two tumours were present. In our series of 66 cases all were single.

2. **Topographical Distribution and Anatomical Relationships.**—In 56 of our series the exact position in which the tumours originated is stated. The relation to muscles and to the umbilicus is shown in *Table II.*

Table II.—Position of Fibromas of the Abdominal Wall (56 cases)

A.—Relation to muscles :—	
a. In recti abdominis	29
b. In oblique and transversalis muscles	27
B.—Relation to level of umbilicus :—	
a. Above umbilicus	10
b. At level of umbilicus	9
c. Below umbilicus	37

These figures may be compared with those of Pfeiffer's larger series, where, in a group of 255 cases, 41 (16·1 per cent) were above the umbilicus, 26 (10·2 per cent) at the umbilical level, and 185 (72·5 per cent) below. There were 3 in the region of the loins. Of the group of 185 cases occurring below the umbilicus, 51 per cent were on the right side of the abdomen, 37 per cent on the left, and 12 per cent in the middle line.

The site of origin differs greatly in different cases, and when the tumours become large they encroach on other areas of the abdominal wall, or may even extend into the iliac fossa or pelvis. They never arise exactly in the middle line, but always a little to one side or the other.

The relations of these tumours to the muscles in which they lie vary with their size and point of origin. While still small they may be found completely embedded in the muscular substance, or, more often, attached to one or other of the fascial sheaths. As the tumour increases in size, its growth takes place along the line of least resistance, that is, in the direction of the muscle fibres, and it assumes in consequence a flattened, oval shape. It also tends to project from the surface of the muscle and to form attachments to surrounding structures, muscles, fasciæ, and bones. It was this secondary bony attachment which led to the erroneous conception of the 'pedicle' as an important and integral part of these tumours, and to Nélaton's theory of origin from the pelvic periosteum. Its frequency is shown by Pfeiffer to be considerable. In his collected series of 400 cases 65 (16·25 per cent) had bony connections, 35 with the ilium, 8 with the os pubis, 6 with floating ribs, and 1 with the spine.

In 2 cases there were attachments to both ilium and os pubis. It may be noted that in *Case* 6 of our own personally observed series, the tumour, which was very large, was adherent both to the iliac crest and to the extremities of the 11th and 12th ribs. In a certain proportion of cases the tumour comes into direct contact with the peritoneum, and may become firmly adherent to it. This is most likely to occur if the tumour has attained a large size or if it is situated above the level of the umbilicus, where there is practically no extra-peritoneal cellular tissue. There appears to be no tendency to perforation of the peritoneum. An appearance of capsulation is frequently met with over certain areas, owing to the surface of the tumour being covered by a fascial sheath. Within the substance of the muscle the margins of the tumour are by no means sharply defined, especially at the poles, where the muscle fibres appear either to penetrate into the growth, or to terminate abruptly on its face. It is impossible to shell it out completely as has been stated by some authors.

The precise tissue of origin is uncertain. It may arise from the aponeurotic sheath of the muscle or from the intramuscular fibrous framework; possibly in some cases from one, in some from the other.

3. **Gross Characters.**—Fibroma of the abdominal wall when of small or moderate size is a densely hard tumour, and contrasts with the softer muscle in which it lies. When cut into, it is both hard and tough, and creaks under the knife. The cut surface is white or pinkish, and glistening, and the interlacing bundles of white fibrous tissue are usually well seen (*Fig.* 268). A number of minute red points, dilated thin-walled vessels, or tiny foci of hæmorrhage, are often present. When tumours attain a larger size they tend to soften in the centre, either from œdema or from mucoid degeneration, and in a few instances they become cystic. It would appear that the density of these tumours may depend to some extent on their site, for tumours removed from the iliac regions are harder and more densely fibrous than those arising in the rectus muscles. It is possible that tumours arising in the groin sooner reach the limits of muscle, and, becoming adherent to comparatively avascular fascial structures, have their own blood-supply interfered with to some extent.

Changes in the skin covering the tumour are unusual, except for a certain amount of thinning when the growth attains a large size. Exceptionally there is adhesion to the skin, which may become œdematous, indurated, or even ulcerated.

The associated lymph-glands do not become enlarged.

4. **Size and Shape.**—As a rule the tumour is discovered accidentally by the patient while it is yet small in size. As it is usually a painless affection in the earlier stages and little likely to cause discomfort, the patients delay seeking medical advice,* and by the time the case is seen by a surgeon the tumour may have attained a considerable size. In 40 cases of our series the size of the tumour at the time of operation is given, usually in the form of a comparison with familiar objects. These include a small nut, a pullet's egg,

* Of 41 idiopathic cases in our series, 21 (51 per cent) gave a history of less than one year 13 (32 per cent) of one to three years, and 7 (17 per cent) of over three years.

an orange, a turkey's egg, the closed fist, the fœtal head, and a child's head. *Table III* gives some indication of the longest diameter measurements of the 40 cases after reduction to mathematical terms.

Table III.—Longest Diameter in 40 Abdominal-wall Fibromas.

Under 5 cm.	12
5–12 cm.	21
12–20 ,, ...	5
20–30 ,, ...	2

The large size of some of the tumours is remarkable: Gross and Sencert's (1905) weighed 6 kilo., Montgomery's (1905) 19½ lb., and Rokitansky's (1880), the largest on record, 17 kilo. Tumours of small size are rounded or oval, and smooth on the surface. As they enlarge they become more oval, or pyriform, and may be either flattened, or bossed and lobulated on the surface.

5. **Histology.**—The following observations are based mainly on the material obtained from the seven original cases here reported. The structure is that of a fairly cellular fibroma occurring in striped muscle. The central portion of the tumour is clearly the oldest, and here the tissue approximates most closely to the adult type. The elongated fibrous tissue cells run in strands and bundles which interlace in all directions, after the manner of the unstriped muscle bundles in a uterine fibroid. At the periphery, where it is infiltrating the surrounding muscle, there is a tendency for the tumour to be somewhat more cellular; but nowhere is there anything in the character of the cells to suggest sarcomatous change. In spite of this the tumour is clearly of an infiltrating type. The absence of encapsulation or indeed of any sharply defined edge within the muscle is most noticeable, and this is true equally of the margins parallel with as of those transverse to the muscle fibres. It is only when the tumour is bounded by a fascial sheath that the appearance of encapsulation is produced.

Fig. 269.—(High power). Margin of tumour, showing infiltration of striped muscle by fairly cellular tumour tissue.

The special features of the tumour are the inclusion in it of striped muscle fibres, and the sequence of regressive changes which these undergo. The earliest change is seen at the periphery, where the striped muscle is being infiltrated and broken up into its constituent fibres (*Fig.* 269). These become stretched and attenuated, and irregular in outline, while the transverse striation tends to disappear. The cytoplasm stains more strongly with eosin, but shows irregular bands and patches of fainter staining. So far the nuclei have

remained in their normal position at the periphery of the fibre, but the next phase shows them evenly distributed throughout the cytoplasm (*Fig.* 270). They are now elongated, rather thin, shrunken, and are present in considerable numbers, giving an appearance very similar to that of the discrete unstriped muscle bundles of the scrotum and elsewhere. We believe that it was this appearance which A. Guinard mistook for genuine unstriped muscle and which led to his enunciating the round-ligament theory of origin. These nuclei take a uniform and dense stain with the basic dye. The next change is a very remarkable one (*Fig.* 271). The cytoplasm swells out and becomes very homogeneous and strongly eosinophilic, while the nuclei also enlarge and become rounded or oval, and vesicular, with well-stained chromatin. They also show quite definitely a peripheral or polar distribution, and as the muscle fibre is now fragmented, or seen in transverse or oblique section, the appearance comes to resemble very closely that of the foreign body or tuberculous giant cell. That these curious plasmodial masses are definitely derived from striped muscle fibres there can be no reasonable doubt, as the stages in the transition can be clearly traced. We interpret the appearances as indicating an assumption of a vegetative, non-functioning existence on the part of the fibre or its fragments, and not a mere degenerative change. It is a de-differentiation, a reversionary change similar to the plasmodial regression of striped muscle so accurately described by Durante (1902), and is brought about by certain ill-defined faults

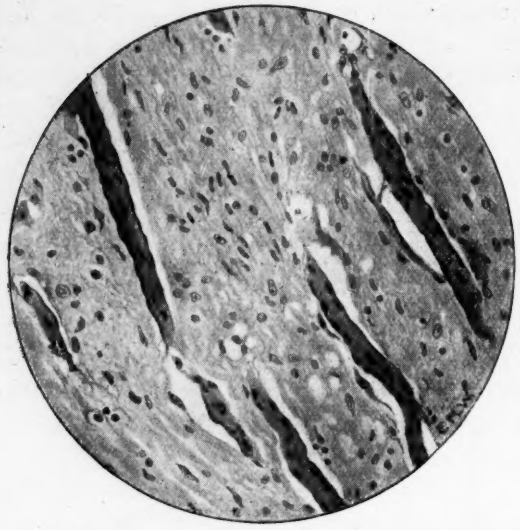

FIG. 270.—(High power). Striped muscle fibres embedded more deeply in the growth, and undergoing the peculiar reversionary change referred to in the text. Note the distribution of nuclei, and the general resemblance to unstriped muscle fibres.

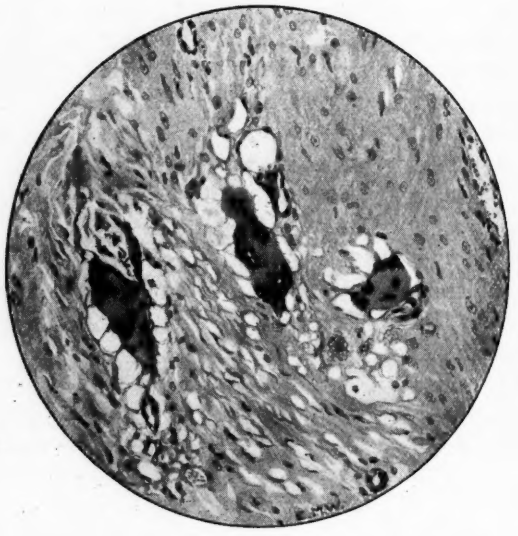

FIG. 271.—(High power). A later stage in the reversionary process, formation of 'muscle giant cells'.

of nutrition or of innervation. There is therefore nothing specific, or pathognomonic of abdominal wall fibromas, about these changes. They are liable to occur wherever there is fibrosis of muscle, but they would appear to be particularly prominent in the case of desmoid tumours, perhaps because of the combination of factors of intramuscular origin of the tumour, progressive infiltration, and slow growth.

In fibromas of large size, especially those which have passed through a period of rapid growth, the centre of the tumour becomes myxomatous or mucoid, and many of the cells, now widely separated, assume a stellate form.

The blood-vessels of the tumour fall into two groups: (*a*) Well-formed thick-walled vessels, often with medullated nerves lying alongside. These are clearly the original vessels of the part, which have become surrounded by and embedded in the growth. (*b*) Simple, thin-walled vessels of embryonic type, mere endothelial tubes, often separated by a narrow myxoid zone from the surrounding fibromatous tissue. These appear to be the new-formed vessels of the growth itself.

3. SIGNS AND SYMPTOMS.

In the great majority of cases the tumour is discovered accidentally. Very often the occurrence of some slight trauma leads to examination, and to the discovery of a lump. This is due to its indolence and painlessness, which also account for the fact that when first discovered it has usually attained a size varying from a nut to a hen's egg. Exceptionally the tumour may be as small as an almond or even a pea, or it may have attained a large size. Subjective disturbances only make their appearance, as a rule, after the tumour has been discovered. There may be intermittent attacks of local or radiating pain, worst at the menstrual periods, and most marked in the case of the more rapidly growing tumours. Tumours situated in the groins are more liable than others to be painful, even when quite small in size.

Fibroma of the abdominal wall is a strictly local condition. It occurs usually in healthy subjects, and, as already indicated, chiefly in youngish women who have gone through one or more pregnancies. Even when the tumour has attained a large size it is exceptional for pressure symptoms to be present, and the signs and symptoms of intra-abdominal mischief are lacking.

While the tumour is still of small or moderate size, a hard, non-tender swelling is palpable in the abdominal wall. It does not implicate the skin, which can be moved freely over it, and, with the abdominal muscles relaxed, it can itself be moved about in certain directions with sufficient freedom to show that it is unconnected with any intraperitoneal structure. This can be further demonstrated by vaginal or bimanual examination. Perhaps the most important single sign is the fact that if the patient is caused to contract the abdominal muscles, the tumour at once becomes completely immobilized (Bouchacourt's sign), to recover its mobility when the muscles are relaxed. Subcutaneous tumours of the abdominal wall are rendered more prominent by such contraction, while intra-abdominal tumours usually become no longer palpable. The corresponding effect on a desmoid tumour will depend on its position in relation to the thickness of the abdominal wall. Even with the

muscles relaxed, these tumours are movable only in certain directions, viz., at right angles to the long axis of the muscle in which they lie.

Tumours of small or moderate size are round, ovoid, or pyriform, flattened or elongated. They are usually smooth on the surface, with well-defined margins, but may be bossed. Desmoids of large size tend to become lobulated, and are no longer uniformly hard. They are still movable in the way described unless they have contracted adhesions, and they are immobilized by muscular contraction. The patients now complain of the discomfort and inconvenience due to the size of the tumour, which tends to project forwards, or even to become dependent. The skin over it is liable to be irritated by friction of clothing, and to become indurated or even ulcerated. This in turn may lead to repeated hæmorrhages and cachexia.

4. DIAGNOSIS.

In tumours of small or medium size, not adherent to bony structures, the diagnosis is usually easy. There is a hard, painless tumour in the abdominal wall, movable against the long axis of the muscle in which it lies, and immobilized by muscular contraction. It has grown slowly, and there is a history (in most cases) of a preceding pregnancy. There is an absence of the symptoms of abdominal or pelvic disease, and the patients are usually young or middle-aged women in good general health.

The diagnosis is much more difficult in the case of tumours of large size, and especially those which have contracted adhesions to adjacent bones. In stout or muscular subjects with a deeply situated tumour an exact diagnosis may be impossible.

In the differential diagnosis various conditions have to be kept in mind, especially other forms of abdominal-wall tumour, tumours of the pelvic bones, and intra-abdominal tumours of various kinds. Cutaneous and subcutaneous tumours—fibroma (including keloid), lipoma, neurofibroma, etc.—are most readily differentiated by the absence of fixation on muscular contraction. Many of them are adherent to the skin, and some are multiple. Desmoids, especially those in the inguinal region, have to be distinguished from hernias, and more especially from small intraparietal epiploceles. Umbilical hernia and middle-line ventral hernias should not cause difficulty, as fibromas are never quite median in position.

Tumours of the pelvis, osteosarcoma, periosteal fibrosarcoma, chondroma, osteoma, may be simulated by large abdominal-wall fibromas which have become firmly adherent to the pelvis. The history will help in such cases, and in most, radiography should be able to settle the question.

Various forms of intra-abdominal tumour may simulate desmoid—tumours of the uterus and ovary, omentum, and gall-bladder, salpingitis, and appendicitis—but the differential diagnosis is usually not difficult.

The greatest difficulty arises in the differentiation of other deep-seated tumours of the abdominal wall—gumma, hæmatoma, intramuscular lipoma, sarcoma, and tumours of the round ligament. In diagnosis, the history and the exact site of the tumour are of the first importance. Round-ligament tumours are strictly limited as to site, sarcomas are usually of more rapid

growth than fibromas, and intramuscular lipomas of the abdominal wall are excessively rare. Gummata are soon accompanied by changes in the superjacent skin, there is a history of syphilis, and the Wassermann reaction may be positive. Hæmatoma, once formed, is stationary, and there is a history of sudden onset following trauma.

5. COURSE AND PROGNOSIS.

Fibroma of the abdominal wall shows considerable variation in its rate of growth in different cases. As a rule, growth is slow, especially in the earlier stages. Not infrequently there is a history that the tumour remained of small size for a number of months or years and then grew rapidly; in other cases growth is slow throughout. In Delbet's (1922) case the tumour took seventeen years to attain the size of the closed fist, in Fieux's (1895) it reached double that size in four months. Rapid growth throughout is exceptional, and should at once raise the suspicion of malignancy—that is, that the tumour is a fibrosarcoma and not a fibroma. The sudden onset of rapid growth in a tumour which had previously been growing slowly or had even been stationary is in an entirely different category. As Labbé and Remy have pointed out, this change is due not to a phase of rapid cellular proliferation, but to the onset of a mucoid or myxomatous change in the tumour, with great imbibition of fluid. *It does not indicate the supervention of malignant change in a previously simple tumour.* Indeed there is little or no evidence to show that a true fibroma of the abdominal wall ever becomes sarcomatous. In most of the published cases in which a sudden increase in the rate of growth has taken place the phenomenon has been definitely related to pregnancy. Most often it has occurred at some period during the course of pregnancy; less often it has followed parturition.

When tumours are left untouched, they may attain, as already mentioned, a very large size, and it is only then that serious impairment of the general health may be met with. Even in these late stages treatment by extirpation is always practicable, at least in so far as local conditions are concerned.

The prognosis in cases of fibroma of the abdominal wall is therefore extremely good. It is a benign growth which never metastasizes, and, even if untreated, is very unlikely to cause death. Cure can be effected by surgical removal of the growth, and if this is done completely there is no risk of recurrence. Even if the peritoneum has to be opened, or a portion of it excised, the operative mortality, in modern practice, is low. In our collected series there has been no operative death in the last thirty-five years, that is to say, in 55 cases.

Pfeiffer (1904) has analysed a series of 261 cases in which the operative treatment was presumably carried out by antiseptic or aseptic methods, but including many which date from the early days of the Listerian method. In 119 cases in which the peritoneal cavity was opened, the operative mortality was 8·4 per cent; in 142 cases in which it was not, the mortality was 2·1 per cent; giving a combined mortality of roughly 5 per cent.

In a few reported cases a second independent tumour has made its

appearance following removal of the first, just as, in one or two instances, two tumours have co-existed in the same individual. Treatment by excision of the new tumour is none the less efficacious.

6. TREATMENT AND RESULTS.

There is only one method of treatment, extirpation, which should be carried out at the earliest possible opportunity. The operation is perhaps less easy to perform than might be expected, especially if the tumour has attained a large size. Most of the earlier writers, including Labbé and Remy, insist on the fact that it is possible to 'shell out' the growth over a considerable part of its extent, with section of little more than the pedicle. We are satisfied that in most cases something more than this is required, and that it is this practice which has been mainly responsible for the heavy recurrence rate reported by these authors. In the cases which we have seen only quite limited areas of apparent encapsulation have been present; over much larger parts of the surface the tumour has been inextricably blended with the fibres of its containing muscle or firmly adherent to surrounding fasciæ. The position has been accurately stated by Lecène and Delamare (1908): "We believe that most of these recurrences, if not all, are due to surgeons following classical (French) teaching and trying simply to enucleate. We now know that this may allow portions of fibromatous tissue to remain behind in the wall of the cavity, having infiltrated the muscle, and these cause the local recurrence." The practical conclusion which they draw is only to enucleate if and so far as the tumour separates with the greatest ease from surrounding parts; wherever there is adhesion, or, *a fortiori*, invasion of muscle, it is necessary to make a frank excision at some distance from the invaded tissues, whether muscles, aponeuroses of insertion, or peritoneum. They perform *resection-enucleation.*

When the tumour is small the gap remaining after excision is easily closed. In the case of larger tumours considerable difficulty may be experienced, and in a very few it may be necessary to pack the wound and allow it to granulate up from the bottom. This was the method adopted in *Case* 6 of our personally observed series, where the tumour was firmly adherent both to the 11th and 12th ribs and to the crest of the ilium.

When the peritoneum is adherent to the tumour it is best to excise the adherent part along with the growth, and not to attempt to strip it off, as was originally the practice.

In our collected series of 66 cases 64 were treated by excision, one by electrolysis (Reed 1888, *Case* 5), and in one the operation was abandoned owing to the peritoneum having been accidentally opened (Reed 1888, *Case* 1). Two cases (Macfarlane 1832, *Case* 2, Reed 1888, *Case* 4) died of peritonitis following operation. In the case treated by electrolysis, considerable shrinkage of the tumour took place; in that in which the operation was abandoned the growth practically disappeared spontaneously. In the remaining cases the immediate results were good.

The later results are given in 20 cases, and in 4 of these, there was recurrence *in situ.* In Stone's (1909) first case the tumour slowly recurred and was

again excised twenty years after the first operation. In Lockwood's (1910) fourth case and in Senlecq and Chenot's (1911) case the recurrent tumours were each removed a year and ten months after the original operation. In Morison and Drummond's (1910) fourth case there was no evidence of recurrence two years after the second excision. The periods of freedom from recurrence in our collected series vary from a few months to several years. In eleven cases the period of observation was 1 year and over, and in three of these 5, 10, and 11 years respectively had elapsed at the time of publication.

In reporting a recent series of 31 cases of intramuscular fibroma, from the Mayo Clinic, 25 of which were situated in the abdominal wall, Nichols (1923) states that complete excision of the tumour resulted in permanent cure in all but one case. Four patients operated on elsewhere came to the Clinic with recurrences, and were apparently cured by operation and radium treatment. In three instances the tumour was not completely excised, and the patients are known to have recurrences. He concludes that complete and early excision of the tumour promises the most satisfactory results, but that radium and Röntgen rays are at least excellent palliative measures in inoperable cases. Of this latter mode of treatment we have no experience.

VI. SUMMARY AND CONCLUSIONS.

1. Fibroma of the abdominal wall is a simple fibrous-tissue tumour arising in the musculo-aponeurotic structures of the anterior abdominal wall, especially below the level of the umbilicus, and tending to infiltrate the muscle in which it lies.

2. It is met with in women who have borne children to the extent of 80 per cent of the reported cases, and it occasionally occurs in the scars of old hernial and other abdominal operation wounds. In other cases there is a history of local injury.

3. A traumatic theory of origin seems reasonable, and the physiological trauma of labour would appear to be of special importance. The infrequency of the condition points to the presence of some additional unknown factor, which, in the absence of more accurate knowledge, may be termed individual predisposition.

4. A peculiar change in the striped muscle fibres enclosed in the growth is described. It appears to be a process of de-differentiation, and results in the formation of multinucleated plasmodial masses resembling foreign body giant cells.

5. Fibromas of the abdominal wall are usually of slow growth in the earlier stages, but with the advent of mucoid or myxomatous change a rapid increase in size may occur.

6. They do not undergo metastasis nor do they endanger life, but there is no evidence that they ever disappear spontaneously.

7. Treatment should be early and complete removal, with resection of a margin of healthy tissue wherever muscle, fascia, or peritoneum is invaded by or adherent to the growth. Recurrence means incomplete resection and demands a more radical operation.

8. There is no evidence that sarcomatous metamorphosis ever occurs.

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CHRONIC INTUSSUSCEPTION: WITH REPORTS OF PREVIOUSLY UNPUBLISHED CASES.

By J. GAYMER JONES, London.

Although most surgeons can recall cases of chronic intussusception, it is a subject which is seldom discussed in surgical literature. By chronic is meant an intussusception which, throughout most and commonly all of its course, is unattended by the symptoms of acute intestinal obstruction. This broad interpretation may bring into the category cases which some would prefer to call subacute because of the severity of the symptoms apart from obstruction, but it serves the useful purpose of encompassing a group of cases which are quite distinct clinically from the acute type.

It has been customary also to divide chronic cases into various subdivisions depending on the age and cause, but the symptoms and signs in all varieties are much the same, and it seems preferable to consider the group as a whole. The notes of fourteen previously unpublished cases are appended. These occurred in Guy's Hospital between the years 1900 and 1924 (March) inclusive, and the writer was able to make observations on four of them. It will be seen that the complaint or its diagnosis has become much commoner during the last few years.

Causation.—On inquiring into the etiology of the condition one finds that a tumour of the gut wall is frequently present as the exciting factor. In this series of 14 cases it occurred in 6; it is much more common to find some such definite cause in adults. Eliot and Corscaden,[1] who analysed 300 cases of all types of intussusception (acute and chronic) in adults, found the presence of a tumour in 100, 60 of these being benign and 40 malignant. The proportion of innocent to malignant in those now reported is 2 to 4. The above writers point out that intussusception occurring in the small intestine is rather more often due to an innocent tumour, whereas in the large intestine the tumour is more often malignant. Of the 6 cases here recorded which were due to tumours, 3 were in the small intestine and 3 in the large. In both sites 2 were malignant and 1 was innocent. Most tumours met with in the intestine have been mentioned in connection with chronic intussusception, and, when innocent, they are usually pedunculated or semi-pedunculated. The 2 innocent growths in this collection were submucous lipomata, while 3 of the malignant were carcinomata. The pathology of the remaining malignant case cannot be stated definitely.

Lesions other than tumours are sometimes the causal agents; thus, most types of intestinal ulceration, e.g., bacillary, typhoid, and tuberculous, have been found. The ulcer of the cæcum in *Case* 8 was considered to be stercoral in origin, and secondary to a recent pregnancy. The starting point has

occasionally been an inverted Meckel's diverticulum, and, more rarely, a lesion of the outer coats of the intestine, e.g., tuberculous peritonitis. It is interesting to note that a pathological condition of the appendix is but seldom to be found as the cause of the trouble, although *Case* 7 would appear to be an instance of such a cause.

Trauma is mentioned in the histories of some otherwise unexplained cases. Eliot and Corscaden found that, when present, it generally proved to be of the nature of a severe muscular exertion. *Case* 9, if the history can be taken as correct, appears to fall into this category.

When all such definite etiological factors have been excluded there remains a number of cases in which no cause can be discovered. Goodall[2] in 1910 made an interesting collection of 122 such cases of chronic primary intussusception in the adult. The absence of any demonstrable lesion is also a feature of the condition when it occurs in young children. Therefore, although one must admit the occurrence of these primary cases, yet some underlying pathology should always be suspected, especially in adults, and should only be excluded after the most thorough search at the time of operation. In this search it may even be necessary to open the bowel. *Case* 1 was of interest in this connection: after reduction of the invagination the submucous lipoma as palpated through the intestinal walls felt very much like a mass of fæces, although on further examination it became apparent that it could only be manipulated for a limited distance in either direction along the lumen.

Age.—Chronic intussusception may occur at any age, but certain groups of cases appear to favour particular periods of life. Those cases which are secondary to malignant tumours are found more often during the latter half of life, whereas those due to innocent tumours occur at any age, although they are uncommon before 10 years. Goodall found that the chronic primary intussusceptions of adults occurred most commonly between the ages of 20 and 40. Still[3] draws attention to the fact that the condition can occur in very young children, and mentions four cases in which the ages were 13 months, 14 months, 23 months, and 3½ years. One infant in the present series was only 8 months.

Duration.—One of the most remarkable features of the complaint is the length of time it may last. It is difficult to realize that one part of the intestine may remain telescoped within the segment distal to it for many months or even longer without something very definite happening to make such an anatomical error obvious; but such a state of affairs is not uncommon in reported cases, and even in children the condition may last for many weeks. In most of the cases here reported the symptoms were sufficiently severe to cause the patients to seek advice at a somewhat earlier date. It is probable that in many cases of long duration the intussusception has not been present all the time, but has undergone spontaneous reduction for periods and then recurred. Such an explanation, however, is not applicable to all cases.

Position.—The position of the intussusception varies somewhat with the cause. When secondary to some form of growth it can occur anywhere in

the intestinal tract; the duodenum is not immune, neither is the rectum; but, as one would expect from its association with a tumour, it occurs most often in those parts of the intestine in which a tumour is likely to be found. Primary cases, whether in adults or young children, usually start in the ileo-cæcal angle; thus, in the cases mentioned by Goodall (adults), 70·3 per cent started in this region, the remaining number being more or less evenly divided between the small and large intestines (15·3 per cent and 13·5 per cent respectively). With regard to children, Still reports 3 ileocæcal and 1 ileocolic; and out of the 5 cases of this type mentioned below, 3 were ileocæcal, 1 was ileocolic, and the remaining one, although not definitely named, started in the same region.

Symptoms and Signs.—Although the symptoms and signs may vary in detail to some extent, most histories agree in certain outstanding features, and these, when grouped together, should lead to a correct diagnosis.

Onset.—This is sudden, and consists of an attack of acute griping pain in the abdomen which may be associated with vomiting. In *Case* 2, which is typical, the patient was suddenly taken ill while out walking and only managed to get home with great difficulty.

Pain.—Pain is one of the most characteristic features of the complaint. Patients will describe it variously as 'colicky', 'griping', 'acute spasms', or 'like labour pains'. It comes on in attacks which last for a few seconds or a few minutes, but may be longer. These spasms recur at intervals varying from minutes to hours, or rarely days, and in most cases the patient is absolutely free from all pain during these intervals. The pains are often increased by taking food, and when frequent keep the patient awake at night. As time goes on the length of the intervals tends to decrease, with the result that the patients become both worn out and pale.

Occasionally all symptoms disappear for long intervals, e.g., three years in *Case* 9, and twenty days in *Case* 3. The most likely explanation of these long periods of relief is that the invagination has undergone spontaneous reduction. There can be little doubt that this does happen, and is merely an extension of the well-recognized fact that intussusceptions, especially when chronic, are often found to vary markedly in length when examined from time to time during the course of the complaint. There are, too, certain instances in which complete spontaneous reduction has been proved. It is interesting that those working in the Children's Department of Guy's Hospital have reason to believe that the pains may subside for a time owing to fatigue of the gut. It would seem that this is the probable explanation of *Case* 10. In this instance there was a prolonged period of relief, although an enormous intussusception was present all the time.

Vomiting.—This is variable and may be absent altogether. When present it may occur only at the onset, or the patient may vomit occasionally throughout the course of the complaint. Even in children, although it is usually present at the onset, it is not necessarily prominent, but should it be present and green in colour it is a most important diagnostic sign.

Bowels.—Although the bowels frequently remain normal, yet some irregularity either in the direction of constipation or diarrhœa is commonly present.

Diarrhœa of a very objectionable nature is encountered when inflammatory changes are occurring in the gut walls (*Case* 2). Young children tend to constipation. Blood, if present at all, only occurs in traces. Slime, also, is not a constant feature, but may be marked when diarrhœa is troublesome.

Wasting.—This is usually very conspicuous, and is due to pain and loss of sleep, and to the fact that as the symptoms are often increased by food the patients prefer to eat as little as possible. It is most severe in children, and in them may lead to errors in diagnosis.

Tenesmus.—This is variable, but may be present to a troublesome extent.

Abdominal Examination.—The abdomen when examined during an interval of relief will be found to be flaccid, and very occasionally a swelling is visible in the region of the underlying intussusception. In the majority of cases a tumour is to be felt on palpation, and this tumour has been well described as 'sausage-shaped'. It is movable to some extent, and slightly tender on deep palpation. From time to time it may be felt to harden and relax, and if a number of examinations are made a variation in its length will frequently be noticed. In some instances it may even disappear altogether, and should this happen during the examination it will make the diagnosis almost a certainty, especially if the disappearance is accompanied by a gurgle. With regard to the palpability of the tumour it should be remembered that if placed high up under the costal margin it may be out of reach of the examining hand.

The number of attacks of pain provide ample opportunity for examination during one of them, and at such times the whole abdomen will be felt to become rigid; it is on these occasions, too, that the intussusception, if still discernible, is particularly liable to vary in its length. During the pains, visible peristalsis should be sought; it is not a constant sign, and is most likely to be seen in the wasted abdomen of a child. An undue emptiness in the right iliac fossa is to be demonstrated in some instances.

Rectal Examination.—This should always be made, as an intussusception not infrequently enters the rectum. It should be borne in mind, however, that it is possible for a growth to obscure an intussusception which it is dragging behind it. It is interesting to note that cases are recorded in which the intussusceptum has presented at the anus and has even protruded for some distance without obstruction supervening.

X-ray Examination.—As there may be but little interference to the passage of the contents of the bowel, it is unusual for an opaque meal to render much help, but a definite narrowing may be shown, and this is especially significant if it is present on re-examination. Schlink[4] reports an interesting case in which the X rays definitely showed an intussusception; the bismuth had, in this instance, found its way between the receiving and returning layers and had remained there after the rest of the meal had passed along.

Differential Diagnosis.—If the characteristic signs and symptoms are present, the diagnosis ought not to be difficult provided the possibility be remembered. The conditions most likely to give trouble in the adult are: (1) Appendicitis with the formation of a tumour; (2) Carcinoma of the colon,

especially cæcum or ascending colon; (3) Ileocæcal tuberculosis; and (4) Distended gall-bladder.

Appendicitis not infrequently causes the formation of a rather sausage-shaped tumour, and if the case is seen after the more acute symptoms have subsided, some difficulty may arise. Such a tumour is usually more fixed than an intussusception, and there will be an absence of those variations in its size which have been described. The history, also, of the continuous character of the pain during the acute stage, and of the rise in temperature and pulse, will help in the diagnosis of appendicitis, and although it must be admitted that cases of this disease do occur in which the pain is spasmodic, it is rare for the spasms to occur with such frequent regularity as they do in intussusception.

Carcinoma of the cæcum and hypertrophic ileocæcal tuberculosis can be taken together, as the signs they present are much the same. In the early stages of these diseases pain and sudden onset, which are such characteristic features of chronic intussusception, are absent; but in the late stages visible peristalsis may be present, and this, together with the tumour and wasting, causes a very real difficulty. Again, there will be an absence of the variations in the tumour, and, when colicky pains occur, the other signs of obstruction will usually be present. In these difficult cases the history of the onset is very important.

A distended gall-bladder gave difficulty in an instance in which it was sausage-shaped—not pyriform—and extended vertically downwards to a lower level than the umbilicus. In such a case, however, the pain is more prolonged, different in character, and associated usually with a rise in temperature. In addition there will not be the frequent attacks of short duration lasting over a long period.

With regard to the differential diagnosis in children, Still found that at least three out of the four cases sent to him had been diagnosed as tuberculous peritonitis. The presence of a transverse swelling below the liver together with wasting led to the error; the tumour had been thought to be thickened and rolled up omentum. Here again a careful consideration of the pain, changes in the tumour, and suddenness or not of onset should prevent such a mistake.

On the Children's side of this Hospital it has been found that both chronic dyspepsia and follicular colitis present a difficulty when a tumour cannot be palpated, whereas when a palpable tumour is present purpura may cause trouble in diagnosis. In chronic dyspepsia the wasting and the pains brought about by fermentation, together with the frequent presence of visible peristalsis (due to the thin abdominal wall), are the causes of the resemblance, but the sudden onset will be absent, and vomiting, although it may not be a prominent symptom in chronic intussusception, does, if green, favour that diagnosis, as such vomiting is rare except in the last stages of chronic dyspepsia. The stools in dyspepsia, although they frequently contain large quantities of mucus, are pasty in character. In chronic follicular colitis the blood and slime may recall intussusception, but the former disease is a sequel of an acute primary attack of the same complaint or follows insidiously on a simple dyspeptic diarrhœa, and there will usually be some degree of temperature

present. The diagnosis also depends largely upon frequent and careful examination of the abdomen.

In Henoch's purpura the hæmorrhage into the intestine may cause a tumour to be palpable through the abdominal wall; in *Case* 13 it was difficult to decide whether the lump was due to such a cause or to an intussusception. The flea-bites which were present only helped to increase the difficulty as the examination was made in artificial light and they resembled markedly the petechiæ of purpura; but the fact that the spots covered the trunk and extremities to an equal degree favoured the former diagnosis, as in purpura they are more numerous on the extremities than on the trunk. In purpura also the swelling and pain in the joints, together with hæmorrhages from other mucous membranes, help in the diagnosis, but it is to be remembered that such signs may be slight or absent altogether.

Discussion.—An inquiry into the factors which determine whether an intussusception is going to be acute or chronic brings out many interesting facts which are apt to be neglected in the text-books. The congestion, inflammatory œdema, and later, if left, ulceration and gangrene, which are the characteristics of the acute type, obviously have their origin in an interference with the vascular supply of the intussusceptum. Obstruction is the clinical manifestation of this interference, and is the result both of the changes in the gut wall and of the occlusion of the lumen. Granting, then, that the determining factor is the presence or not of some obstruction to the vascular supply of the invaginated portion, upon what does it depend?

Waugh[5] reports three cases of chronic intussusception in children in all of whom it was found that the large intestine had retained its primitive mesocolon.* In addition to this there were other evidences of failure to undergo complete development; the appendix in each case was large, in none had the mesocolon of the transverse portion of the gut fused with the layers of the omentum, in one a Meckel's diverticulum was found, and in another a congenital hernial sac. It is clear that the persistence of a mesentery to the colon will permit of the invagination proceeding to a greater distance without dragging on the vessels, and, further, it will allow the ensheathing layer to be taken up easily into the returning layer as the intussusception moves along, with the result that the neck of the intussusception will not remain as a rigid point around which the mesentery of the invagination will kink.

The ease with which the ensheathing layer can be taken up or unravelled in chronic cases is well displayed at operation, and although the presence of a primitive mesocolon is not always to be found, yet it can be shown usually that the so-called fixed parts of the colon are unduly mobile. Fitzwilliams[6] draws attention to the fact that after reduction it can frequently be demonstrated that a mesentery has been formed by a process of 'borrowing'

* In this interesting paper Waugh draws attention to a peculiar symptom which existed in all three cases, viz., the presence of paroxysmal attacks of pain referred to the end of the penis and to the suprapubic region.

from the parietal peritoneum, and in the operation of colectomy Sir Arbuthnot Lane has shown that the same result can be brought about by a little traction on the fixed parts of the colon. The amount of mesentery, however, which is available is much greater in some individuals than in others; it is probably the length of the mesentery, or the ease with which it can be formed or increased in length, that determines whether or not the intussusception will be chronic.

It is also possible that in addition to the above factors the tone of the muscles of the ensheathing layer is of importance, inasmuch as spasm of these muscles may interfere with the flow of the blood in the mesentery of the intussusceptum.

Treatment.—The treatment of this complaint must obviously fall to the lot of the surgeon, and although not a surgical emergency, there should be no delay in operating once a diagnosis is made. Drastic purgatives should not be given lest the case be converted into one of acute intussusception (*Case* 1).

Reduction is in most cases easy. Some degree of œdema of the gut walls is found usually, but not always; and if the invagination is of long standing, adhesions between the serous surfaces may have occurred. These latter, although making reduction more difficult, do not necessarily make it impossible. When a growth is found after reduction it is generally possible to deal with it at once, and removal in these cases has been followed by very good results. Should adhesions prevent reduction, then excision of the intussusception, or of the intussusceptum, or a short-circuiting operation, are the courses available. In deciding which should be done, due consideration should be given to the possibility of an underlying pathological lesion. In the adult, conditions permitting, excision of the whole intussusception is preferable on account of the frequency with which some form of growth is found, whereas in the infant the object is to interfere as little as possible, and the question of what should be done can only be decided after careful consideration in each individual case.

It is usually unnecessary to perform any operation for the prevention of recurrence, but some such procedure may be advisable in cases where there is a definite history of recurrent attacks. In such circumstances pleating of the mesentery, fixation of the appendix to the abdominal wall (Alexander[7]), or colopexy can be used; but again it is necessary to exclude beforehand the presence of a small pedunculated tumour within the lumen of the bowel.

An interesting question occasionally arises. A case may have been seen and diagnosed as one of chronic intussusception, but before operation all signs and symptoms may have disappeared. Is operation justified? If the patient is an adult and there is nothing in his general condition which would contra-indicate it, there can be little doubt that, bearing in mind the strong possibility of some tumour being present, the wise and safest course would be to do a laparotomy. *Case* 3 is a good example of an intussusception leading to the discovery and excision of an early carcinoma. In the case of an infant there would be no such definite reason for operating after spontaneous reduction had occurred.

REPORT OF CASES.

Group I.—Due to Innocent Tumours.

Case 1.—A. E. G., male, age 7. Admitted Sept. 7 1923 for abdominal pain.

HISTORY.—For the fortnight previous to admission the patient had suffered from recurrent attacks of colicky abdominal pain, of which the onset was sudden and the duration a few seconds only, with intervals of complete relief. They numbered about six in the twenty-four hours, and sometimes occurred while he was playing in the street. He would, at these times, run to his mother, only to return to play again immediately the spasm was over. Bowels were opened normally every day. The pains increased in severity during the three days before admission. He was given a purge twenty-four hours before admission, and since that time the pain had been continuous and he had passed no fæcal matter. Some blood and slime were passed shortly before admission.

EXAMINATION.—Child in severe abdominal pain. Abdomen held somewhat rigidly. A sausage-shaped tumour could be seen pushing the anterior abdominal wall forwards in the upper left quadrant. On palpation this seemed to correspond to the left half of the transverse colon and descending colon. *Diagnosis*: Supervention of acute on chronic intussusception.

OPERATION, Sept. 7.—A certain amount of free fluid present in peritoneal cavity. An intussusception was found involving the terminal half of the transverse colon, descending colon, and the upper part of the iliac colon. Reduction easily performed. There was no congestion and but little œdema. On further examination a soft mass about the size of a walnut could be felt in that part of the transverse colon which had formed the apex of the intussusception. Although somewhat like a fæcal concretion, it was found that it could only be manipulated a very limited distance in either direction along the colon. On removal it proved to be a semi-pedunculated submucous lipoma growing from the posterior wall of the colon. The child made good progress and was discharged on Sept. 24.

It is interesting that acute obstruction appeared to be determined by the use of a purgative.

Case 2.—E. B., female, age 53. Admitted Jan. 29, 1923, for abdominal pain.

HISTORY.—Good health except for rheumatic fever between the ages of 19 and 25. She has always been anæmic. Eleven days before admission the patient, when out shopping, was seized with acute abdominal pain originating in the right iliac fossa and spreading over the whole abdomen. The pain was so severe that the patient only managed to get home by supporting herself against the wall. Since then the attacks have recurred, usually at five-minute intervals, but occasionally she has been free for as much as half an hour. The attacks last about two minutes, and during the interval there is complete relief. No vomiting. Bowels open, and the patient describes the motions as slimy and of a particularly objectionable odour. For five days previous to admission she has refrained from eating solid food as the pains were made worse thereby.

EXAMINATION.—Patient well covered. Abdomen moves well. On palpation a large sausage-shaped tumour can be felt in the right iliac fossa; it is firm in consistency, with its long axis in the vertical plane. It can be moved laterally to some extent, but not in the vertical direction. Some tenderness on deep pressure. *Diagnosis*: Chronic intussusception.

OPERATION, Jan. 30.—This disclosed a considerable amount of clear fluid in the peritoneal cavity. A double intussusception was found. The outer one reduced easily and its apex was formed by the ileocæcal valve. There was such marked congestion and œdema of the inner intussusception that complete reduction was impossible. It consisted of the terminal few inches of the ileum. Resection was performed. On examining the resected portion a sloughing pedunculated submucous tumour about the size of a marble was found, which on microscopical examination

proved to be a "necrotic and suppurating lipoma". The patient did well and was discharged on Feb. 24.

This patient was admitted a year later for adhesions, and a short length of the terminal ileum was short-circuited. Discharged fit.

Group II.—Due to Malignant Tumours.

Case 3.—R. C., male, age 43. Admitted Aug. 27, 1923, for paroxysmal attacks of abdominal pain.

HISTORY.—On Aug. 3, he was suddenly doubled up with acute abdominal pain while at work. The attack lasted about four minutes and then completely passed away. He had several similar attacks on the same day, with intervals of complete freedom from pain. The following day he suffered from diarrhœa. On Aug. 23 the pain commenced again and occurred in attacks similar to those before. After each paroxysm he was seized with a painless desire to defæcate, but only passed small quantities of fluid per rectum. He noticed neither blood nor slime. The pains were not influenced by meals. He vomited the next morning. The pains again subsided somewhat.

EXAMINATION.—An indefinite swelling could be palpated on the left side of the abdomen, but a little later this had disappeared, and the pains, which had become less, eventually subsided. He had relief for a number of days, but the attacks started again on Sept. 8. These now lasted about five minutes, with intervals of only a few seconds. Diarrhœa again became marked, and now specks of blood and small quantities of slime were noticed. The tumour also became palpable again in the region of the descending and pelvic colons. The pain kept him awake at night. Occasional vomiting. *Diagnosis*: Chronic intussusception.

OPERATION, Sept. 11.—Immediately before removal to the theatre the lump was easily felt in the left iliac fossa, but when examined again under the anæsthetic it had decreased much in size, and could only be palpated in the region of the upper part of the descending colon. On opening the abdomen an intussusception was found, involving the splenic flexure and descending colon. It was easily reduced, and when this had been done the apex was found to be formed by a small carcinoma of the splenic flexure. Resection performed. Discharged fit.

Case 4.—A. B., female, age 48. Admitted March 4, 1923, for abdominal pain.

HISTORY.—Indigestion for the last two years. Appendicectomy three or four months before admission. This had relieved the pain in the right iliac fossa, but patient occasionally had attacks of a dull aching pain in the epigastrium at night. Three weeks previous to admission patient experienced attacks of colicky pain and marked vomiting. The attacks lasted about ten minutes and were followed by intervals of complete relief for two or three hours. The pain was relieved somewhat by vomiting, but disturbed the patient's sleep. These symptoms continued for about ten days and then she had a week's relief before they started again. She was constipated during the attacks. No blood or slime.

EXAMINATION.—Patient is pale and has lost a great deal of weight. No mention of physical signs except the absence of tenderness. X-ray examination showed the stomach and duodenum greatly dilated.

OPERATION, April 5.—An intussusception was found in the jejunum about 8 inches from the duodenojejunal flexure. It was difficult to reduce, but when reduction was completed the apex was found to be formed by a growth. Resection performed. Patient discharged fit. Section of growth showed "colloid columnar-celled carcinoma of jejunum".

When examined a year later this patient was looking particularly well.

Case 5.—H. T., male, age 39. Admitted Aug. 21, 1905.

HISTORY.—Eleven weeks ago patient had an attack of abdominal pain and bleeding from the bowel. The attack lasted twenty-four hours. Three weeks later a similar attack occurred, but the pains were severer. Since that time patient

has suffered from attacks of abdominal pain about three times a week. The pains are accompanied by tenesmus.

EXAMINATION.—After admission the patient had periods of abdominal pain, and on the fourth day a lump was palpable in the left hypochondrium. The lump varied in length at subsequent examinations, and mucus and blood were passed when the attacks were severest. *Diagnosis*: Intussusception probably produced by growth.

OPERATION, Aug. 30.—Intussusception of descending colon found, caused by a growth which incompletely surrounded the lumen of the gut. Resection performed and an end-to-end anastomosis made. On discharge patient had a fæcal fistula.

The fact that an end-to-end anastomosis was performed in 1905 is of interest. When examined ten years later this patient was well and the fistula was healed.

Case 6.—H. B., male, age 40. Admitted March 18, 1906, for pain in the abdomen.

HISTORY.—Healthy previous history. Abdominal pain started 'last Saturday week'. It is situated in the hypogastrium and occurs in attacks which 'grip' him. The attacks come on every ten minutes and keep him awake at night. He vomits occasionally. There is no rectal pain.

EXAMINATION.—A hard mass is to be felt in the region of the umbilicus. It is very tender. It can be moved up and down, but very little laterally.

OPERATION, March 22.—Intussusception of lower end of ileum caused by growth. Resection. Patient died March 27.

In this case there is some doubt as to whether the tumour was a carcinoma or sarcoma.

Group III.—Due to Appendicitis.

Case 7.—J. S., male, age 12. Admitted Aug. 6, 1905, for abdominal pain and vomiting.

HISTORY.—A fortnight's history of loss of appetite, vomiting, and abdominal pain; the vomiting became a very marked feature.

EXAMINATION.—Patient is thin and pale. No pain. Lump palpable in the right iliac fossa. After a few days this lump appeared to become somewhat smaller in size, but to ascend in position. It was not tender. Bowels open daily while in hospital.

OPERATION, Aug. 13.—Intussusception found. It consisted of cæcum, appendix, and about 1½ in. of ileum. The appendix, 4 in. in length and about 2 in. in circumference, was found in the fœtal position: its distal end contained fluid, the lumen being obliterated proximally. Intussusception was reduced and appendicectomy performed. The stump was not invaginated. Discharged fit.

Group IV.—Due to Innocent Ulceration.

Case 8.—E. D., female, age 39. Admitted Aug. 3, 1920, with abdominal pain.

HISTORY.—Patient's youngest child was born four months previously. Three days before admission patient suddenly experienced cramp in the abdomen. These pains she likened to the 'bearing-down' pains of childbirth. They occurred at half-hourly intervals and there was complete relief between the attacks. The pains interfered with sleep and were increased by food. Vomited at onset. Diarrhœa present, the stools containing blood.

EXAMINATION.—Patient is an anæmic woman. A tender sausage-shaped tumour palpable in the region of the upper part of the ascending colon and the first part of the transverse colon. *Diagnosis*: Chronic intussusception.

OPERATION, Aug. 6.—No tumour could be demonstrated, but the cæcum and appendix were œdematous and appeared as if they had been invaginated. The pathological condition of the cæcum was doubtful and it was decided to remove it. An anastomosis was made between the ileum and the upper part of the ascending

colon. On examination of the cæcum after removal, ulceration of the mucous membrane was found. The clinical microscopist reported "inflammatory ulceration of the cæcum and appendix".

This ulceration was considered to be secondary to the recent pregnancy. Three years later this patient was operated upon for obstruction caused by a band. She made a successful recovery.

Group V.—Due to Sudden Exertion.

Case 9.—D. Y., male, age 28. Admitted Aug. 7, 1920, with abdominal pain.

HISTORY.—Healthy previous history. In the summer of 1917 the patient was carrying a gas cylinder when his right foot slipped into a shell hole. He was seized with abdominal pain which lasted, in attacks, for two or three days. There was no vomiting. Bowels normal. He reported to the medical officer and was given a 'No. 9'. The duration of the attacks was about ten minutes, and the intervals between them about three hours. The pains would travel all over the abdomen and then settle in the region of the umbilicus. After this occasion he was free from pain until about a month before admission, i.e., for an interval of three years. On this second occasion the pain started suddenly. It was not very severe, and the attacks would last about two minutes, with five-minute intervals. During the intervals he was entirely free. The symptoms gradually subsided, but recurred occasionally in griping spasms chiefly in the region of the umbilicus and right iliac fossa. Bowels normal. Five days before admission the pains became more severe and kept him awake during the night. He vomited six times. On the following day he was better, but he continued to have spasms at intervals until admission.

EXAMINATION.—An ill-defined swelling could be palpated to the right of the umbilicus.

OPERATION, Aug. 7.—A chronic intussusception was found. It involved the cæcum, appendix, and ascending colon. Reduced. Discharged Aug. 21.

This patient was quite fit when seen three and a half years later.

Group VI.—Primary Cases in the Adult.

Case 10.—E. R., female, age 34. Admitted Aug. 18, 1913.

HISTORY.—About six weeks ago patient commenced having griping pains in the abdomen. The pains came on in attacks which lasted about ten minutes and occurred three or four times a day at the beginning, becoming more frequent later. In the intervals the patient was free from all pain. The pains were made worse by food and kept patient awake at night. Bowels constipated and enemata required. There was some blood in the fæces at the commencement.

After admission the bowels became more or less regular, and 'lumps' could be felt on the right side of the abdomen. A laparotomy was performed, but the patient's condition caused grave anxiety and the abdomen had to be closed before the exact state of affairs had been disclosed. Nevertheless a tumefaction of the colon was noticed in the region of the hepatic flexure, transverse colon, and descending colon. After this operation the pain, although it still occurred, was not so persistent, and she would have periods of relief for about three days, followed by similar attacks. The bowels were fairly regular. For a week before the second operation, which was six weeks later, the patient had no pain at all. At the second operation an intussusception was found, the ascending colon, cæcum, appendix, and lower part of ileum being invaginated into the transverse colon. The parts were rather inflamed and the appendix was adherent. Reduction was performed and the appendix removed.

When seen ten years later the patient had had no recurrence of the symptoms.

Group VII.—Primary Cases in Children.

Case 11.—J. B., male, age 8 months. Admitted Sept. 18, 1922, for vomiting and diarrhœa.

HISTORY.—Breast-fed up to three months ago. Since then cow's milk during the day while mother was at work. Constipated since birth. A month previous to admission the baby commenced to vomit all his feeds, and a week later had diarrhœa in which mucus and streaks of blood were present. The diarrhœa has alternated with constipation and the vomiting has continued to be marked. The baby has wasted considerably.

EXAMINATION.—Weight 6,000 grm. Extremely pale and drowsy. Abdomen generally tender, but no tumour palpable. Abdominal wall very thin. Sept. 20. Patient has vomited after two feeds but has kept down the others. Stools loose, but no visible blood or mucus. Sept. 21. Small intestine peristalsis visible, Elongated, vertical swelling felt under right costal margin. Nothing felt per rectum. Opaque meal arrested in small intestine. *Diagnosis*: Chronic intussusception?

OPERATION, Sept. 22.—An ileocolic intussusception was found. This was reduced from about one foot to three inches. Adhesions prevented further reduction of the remaining portion in the ileum. Ileocolostomy performed. Death a few hours later.

Case 12.—K. S., male, age 11 months. Admitted March 28, 1924.

HISTORY.—Eight days before admission the baby was suddenly taken ill with violent pains in the abdomen. He vomited frequently and "passed a night made horrible by his dramatic attacks". The pains occurred every ten to twenty minutes, and continued until the day of admission. For the first few days the baby was constipated, but then passed an offensive motion streaked with blood and slime. The bowels were then opened daily for the next three days; blood and slime were noticed in the stools. For two days before admission the bowels had not worked except for the frequent passage of blood and slime. The child vomited throughout the complaint, the vomit on many occasions being green in colour. The pains woke the child at night.

EXAMINATION.—Child wasted. Horseshoe swelling present under umbilicus.

OPERATION, March 28.—Ileocæcal intussusception found extending to within one inch of the splenic flexure. A short re-intussusception of the ensheathing layer had occurred half-way along the transverse colon. There was œdema of the intussusceptum, but no inflammation. Intussusception reduced. Discharged fit.

This case had become acute forty-eight hours before admission.

Case 13.—A. S., female, age 9. Admitted Feb. 2, 1923, for abdominal pain.

HISTORY.—For the fortnight previous to admission the patient had been suffering from attacks of abdominal pain—most violent at night. The attacks would last about ten minutes, and occurred five or six times during the day, but were more frequent during the night. Patient had complete relief during the intervals. No vomiting. Bowels regular. No blood, but a little slime. The attacks became more frequent and resulted in the child becoming exhausted.

EXAMINATION.—Visible and palpable swelling just to right of epigastrium. Visible peristalsis. Attacks brought on by examination of abdomen, and during the attacks the peristalsis was most marked. Stools normal. The patient's trunk and arms were covered with flea-bites.

OPERATION, Feb. 2.—Ileocæcal intussusception found. Reduced. Appendicectomy performed. Discharged fit. The differential diagnosis is an interesting feature in this case, and is dealt with in another part of the paper.

Case 14.—M. T., female, age 5. Admitted March 7, 1918, for pain in abdomen.

HISTORY.—Six weeks ago patient had pain in her abdomen. Her bowels were opened normally, but she experienced pain on defæcation. She was given medicine which relieved the pain. A week ago the pain commenced again, but was worse than before and caused the child to double herself up. There was a desire to defæcate when the pain started. Patient is losing weight and has a craving for water.

EXAMINATION.—Tumour in right iliac region. Pain on palpating abdomen.

OPERATION, Mar. 8.—Ileum invaginated into ascending colon. Some adhesions. Reduced and appendicectomy performed. Discharged fit.

Case 15.—M. O'C., female, age 3. Admitted Oct. 21, 1913, for abdominal pain.

HISTORY.—Duration over forty-eight hours. Abdominal pain with intervals of rest. Sick several times, the vomit being green. Motions normal. No blood.

EXAMINATION.—Tumour in region of transverse colon. Occasional visible peristalsis. A prominence is occasionally visible in the position of the tumour.

OPERATION, Oct. 21.—Ileocæcal intussusception found. No evidence of inflammatory changes was present, and reduction proved easy. Discharged fit.

This patient had had a similar attack about a year previously. The vomit was green on this occasion also. The attack passed off in a day or two. This case is reported by Mr. W. H. Ogilvie in the *Guy's Hospital Gazette*, Nov. 22, 1913, but is included to complete the series.

I beg to thank the members of the Staff for their kind permission to publish these cases, and Dr. A. A. Osman for his help in connection with the part of this article which deals with children.

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SHORT NOTES OF RARE OR OBSCURE CASES

A CASE OF NON-ROTATION OF MID-GUT LOOP LEADING TO VOLVULUS OF THE CÆCUM.

By MICHAEL W. BULMAN, Norwich.

It is uncommon to meet cases in which urgent abdominal symptoms are the result of gross malposition of the viscera. In the case about to be reported, the symptoms were clearly those of intestinal obstruction, the cause of which could not be diagnosed before operation. It was possible at the post-mortem examination to demonstrate the complete extent of the abnormality, and as reported cases of this condition are few, as full a record as practicable of this case has been made.

Mr. B., age 76, was admitted to the Norfolk and Norwich Hospital on May 18, 1924.

History.—As far as can be ascertained the patient had been healthy all his life, and had suffered from no abdominal trouble till about three years ago. He then began to complain that after stooping, as for instance when doing up his boots, he would feel something slip out in the right lower abdomen, and this he described as his 'rib slipping out'. When this happened he would lean back in his chair and press the right side of the lower abdomen upwards and backwards as though to lift something into place. Two days before admission to hospital he was wakened at 4 a.m. with severe abdominal pain, and vomited once. The pain was referred to the umbilicus and the left hypochondrium, and was colicky in type. He was unable to pass wind downwards, but was constantly belching wind, and this act caused pain in the left hypochondrium. On the day of his admission he again vomited; Dr. Sturdee, of Walsingham, was called in, and at once sent him to hospital.

Examination.—Pulse, 104; temperature, 97·8. The tongue was dry and furred, the skin dry and earthy, and the eyes were sunken. The abdomen was greatly distended and was tympanitic all over, the tympanites being particularly marked in the left hypochondriac region. Peristalsis was not seen, and no tumour was made out. There was a small right femoral hernia, but this appeared not to be strangulated. Nothing abnormal was detected per rectum.

Operation.—In spite of the fact that the femoral hernia was thought not to be strangulated, it was deemed advisable first to explore this. The sac was found to contain only a small quantity of cloudy, straw-coloured fluid; the sac was removed and the incision closed. The abdomen was then opened by a right paramedian incision, and distended coils of small intestine immediately presented in the wound. On passing the hand down into the right

iliac fossa, the cæcum could be felt; but after displacing the small intestine to the right, the cæcum was found under the left costal margin, black in colour, completely gangrenous, and distended to a capacity of about 1½ pints. After puncturing it, it was possible to draw the cæcum down into the right iliac fossa, and it was now seen to be twisted one turn in an anti-clockwise direction round a narrow pedicle situated in the right iliac fossa; the ileocæcal artery was thrombosed. The ascending colon was found to be passing up to the left of the mesentery of the small intestine, while the ileum terminated in the right side of the cæcum. As the condition of the patient was urgent, the cæcum was rapidly resected, tubes being passed into the cut ends of the gut and brought out through the lower part of the incision. The patient died a few hours after the operation.

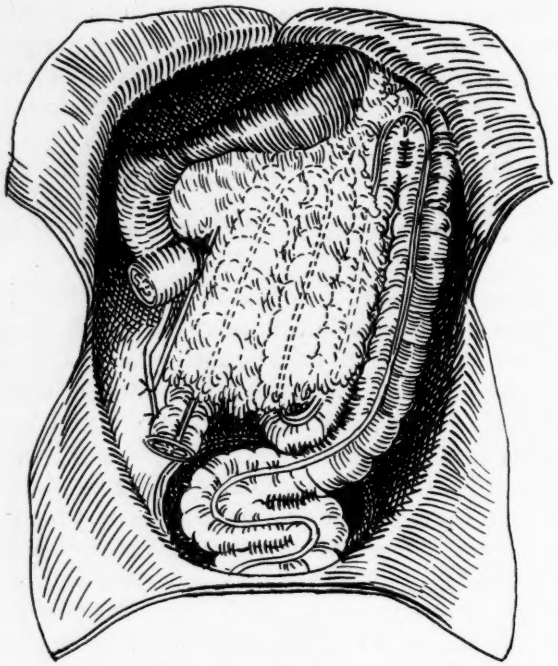

FIG. 272.—Diagram showing the position of the colon and of the duodenojejunal flexure. The small intestine has been omitted for the sake of clearness. The short mesentery of the small intestine is shown extending down from the duodenojejunal flexure, and the site of the pedicle on which the cæcum had twisted is indicated by the ligatures. The omentum is seen covering in the ascending colon, the proximal part of the transverse colon, and to some extent the distal part of the transverse colon as well.

POST-MORTEM.—Post-mortem examination showed that, while the splenic flexure was situated in its normal position, the ascending colon passed from the right iliac fossa upwards and to the left, the hepatic flexure being in contact with the splenic flexure under cover of the greater curvature of the stomach. The transverse colon formed a loop extending down to the pelvic brim between the ascending and descending colon. The sigmoid colon was abnormally long, being composed of two loops which were bound to each other and to the pelvic wall by peritoneal adhesions. The great omentum, passing down from the greater curvature of the stomach, was attached to what represented the upper border of the transverse colon, and from here stretched across the proximal loop of the transverse colon and the ascending colon, to be attached to the root of the mesentery of the small intestine.

The peritoneal relationships of the colon were difficult to make out. The

adjoining edges of the colon were covered by broad, sheet-like peritoneal adhesions, and after dividing these, one appeared to pass straight through into retroperitoneal cellular tissue. There was no definite transverse mesocolon, but this appeared to be represented by a sheet of condensed cellular tissue which allowed the colon to be drawn about three inches forward from the posterior abdominal wall, and which carried the blood-vessels and lymphatics. The arteries to the colon were distorted, but were normally distributed; the branches of the superior mesenteric artery were so short as to prevent replacement of the hepatic flexure in its normal position. The superior mesenteric vein was normally placed, but was joined about one inch below the pancreas by the inferior mesenteric vein. The duodenum was normally fixed by peritoneum; but the duodenojejunal flexure was situated to the right of the mid-line opposite the third lumbar vertebra, and from this point a short mesentery for the small intestine passed downwards for about two inches into the right iliac fossa. (*Fig.* 272.)

This case is clearly one of non-rotation of the mid-gut loop during the second stage of intestinal rotation, and the embryology of the condition has been so clearly stated by Dott[1] that it needs no repetition.

From the position of the pedicle of the twisted cæcum as seen at operation it would appear that the cæcum normally lay in the right iliac fossa, possibly being pushed down into the pelvis when the intra-abdominal pressure was raised, thus giving rise to the feeling of something slipping in the lower abdomen. The position of the cæcum under the left costal margin at the time of operation is probably to be explained on the assumption that, as it became distended after torsion had occurred, it tended to follow the line of least resistance, being guided upwards and to the left by the mesentery of the small intestine. With the patient lying in bed there would be no great tendency for it to fall into the pelvis, as might occur when he stooped.

In a series of 48 cases reported by Dott (loc. cit.), only 13 gave rise to symptoms, and of these 13 cases, only 1 occurred in old age. Volvulus of the ileocæcal segment, such as was observed in this case, would seem to be the typical cause of symptoms in old age, and is probably the result of over-distention of the cæcum.

I have been unable to find any reference to a similar unusual termination of the inferior mesenteric vein in the superior mesenteric vein, a full inch below the formation of the portal vein in this case; but Cunningham[2] states that "it occasionally terminates in the angle of union between the splenic and superior mesenteric veins".

I am indebted to Dr. Sturdee, of Walsingham, for much information as to the past history of the case.

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[2] Cunningham, *Text-book of Anatomy*, 4th ed., 993.

SARCOMA OF METATARSUS IN AN INFANT.

By A. H. SOUTHAM, Manchester.

Sarcoma arising from the bones of the hand or foot appears to be a disease of exceptional occurrence. Bland-Sutton states that owing to the rarity of the condition, little is known of its clinical course. The following case in a child, who was recently under my care, appears, therefore worthy of record.

Fig. 273.—Sarcoma of the metatarsus in an infant.

The patient, a girl, when two months old, was found to have a small tumour growing from the periosteum of the metatarsal bone of the left great toe. The growth was removed locally by her doctor, but rapidly recurred. When seen two months later there was a large fungating growth, which bled easily, involving practically the whole dorsal aspect of the foot (*Fig.* 273). A small piece was removed for microscopical examination, and Dr. A. Sellars reported that it was a mixed-celled sarcoma.

In January, 1924, the child was admitted to the Royal Manchester Children's Hospital. No secondary deposits were discovered in the lungs on X-ray or clinical examination, and at the request of the parents the limb was amputated through the middle of the thigh on Jan. 30.

The child made a satisfactory recovery after the operation and went home, but died about a month later from what was considered to be pneumonia. No post-mortem examination was obtainable, but it appears not unlikely that death was due to secondary growth in the lungs. Examination of the tumour showed it arose from the metatarsus, and had the structure of a sarcoma of the mixed-celled type.

It appears from the scanty information available that these tumours are intensely malignant, and, as in other sarcomata of infants, recurrence may be expected at an early date. Present-day methods of treatment seem to have little influence on the high mortality. A course of Coley's fluid might be useful, and it was hoped to have tried it in this case if the child had survived.

CASE OF EPITHELIOMA OF THE PENIS.

By E. W. JOHNSON, Liverpool.

This case seems to be worth recording, because it presents certain interesting features, and also because pictures of such marked cases are not usually seen in the common text-books.

The patient was 35 years old. He gave a history of syphilis five years previously, for which he said he received treatment and was circumcised. His own doctor confirmed this statement. The duration of the present condition was six months. He thought it was a recurrence of his syphilitic trouble, and did not seek medical advice until the growth attained the size seen in the photograph (*Fig.* 274). The Wassermann reaction of the blood was positive.

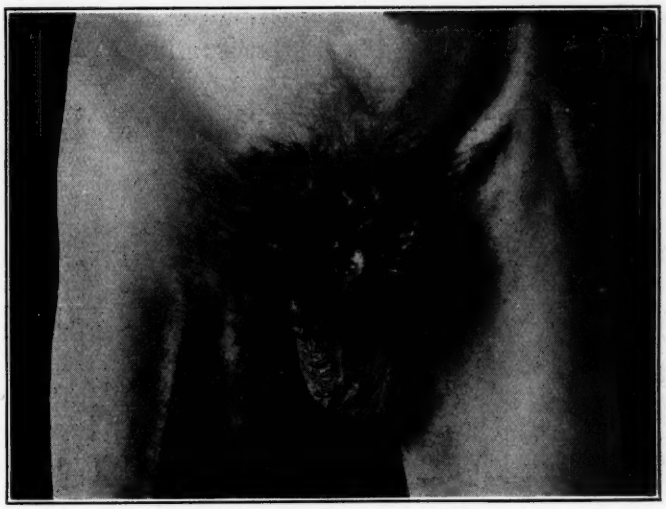

Fig. 274.—Epithelioma of the penis.

The typical 'cauliflower' appearance, invasion of the scrotum, and the involvement of the inguinal glands, are well shown in the figure. Microscopical examination of a portion of the growth revealed that it was a typical epithelioma (Professor J. M. Beattie).

The interesting features of the case are :—

1. The age of the patient. Epithelioma of the penis is rarely present before the age of 40.[1]

2. The history of syphilis and the positive Wassermann reaction.

3. The fact that he had been circumcised. Rose and Carless say that epithelioma of the penis rarely arises except in patients who are subjects of congenital phimosis or possess long foreskins, and hence it is stated that the disease is unknown amongst the Jews.[2]

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[2] *Manual of Surgery*, Baillière, 9th ed., 1273.

A CASE OF FIBROSARCOMA OF THE ORBIT WITH MULTIPLE SECONDARY DEPOSITS.

By CECIL P. G. WAKELEY, London.

Fibrosarcomata are tumours of unusual interest from the fact that it is so difficult to correlate the clinical course with the histological findings. At times a tumour with definite histological appearances of malignancy behaves like an innocent tumour, and its removal effects a permanent cure. In other cases tumours with an identical histological picture grow and metastasize with great rapidity. The following case is of interest because of the large number of secondary deposits which were found.

Fig. 275.—High-power view of tumour removed from the orbit. Typical fibrosarcoma.

George P., age 64, a waiter in an hotel, first noticed some pain in his left eye during February, 1923, and also found that his sight was very poor in that eye. A month later he came to King's College Hospital. On examination it was seen that the left eye was displaced upwards and inwards. There was also proptosis of this eye, so that the anterior part of the cornea lay 8 mm. in front of a line drawn from the prominence of the eyebrow to the malar eminence. There was lachrymation from the left eye, and œdema in both lower lids. There was some local tenderness, but no abnormality of the margins of the orbit was palpable. Vision was: R.V. = Able to read; L.V. = Perception of light only. There was well-marked papillœdema in the left fundus. Nothing abnormal was detected in the nose or nasal sinuses. On May 17, Mr. L. V. Cargill completely removed the contents of the left orbit. A hard round swelling of the size of an olive was found, attached by a pedicle to the periosteum on the outer side of the floor of the orbit at the external canthus; it was completely free from all other structures. The tumour was removed, together with the adherent periosteum. Healing took place rapidly.

The tumour proved to be a fibrosarcoma (*Fig.* 275). Twelve days after operation 100 mgrm. of radium were introduced into the left orbit for twelve hours. X-ray therapy was commenced in June. In July the lower part of the left orbital cavity was skin-grafted; the grafts, which were taken from the leg, were all successful, and the patient was discharged ten days after this operation.

FIG. 276.—Section through the liver, showing the numerous secondary deposits.

In September, 1923, the patient was readmitted to hospital complaining of 'indigestion', which was worse after food. He stated that since his last operation nine weeks previously he suffered much discomfort from time to time after meals. He also stated that he suffered from shortness of breath on any exertion; he never had any actual pain or nausea or vomiting. He had never been jaundiced. He had not lost any weight since his last stay in hospital.

On examination there were no abnormal physical signs in the thorax. The abdomen was slightly distended, but there were no signs of ascites. The liver was found to be an inch below the costal margin.

The patient was quite comfortable in bed, and only complained of occasional pain between the shoulders. The liver increased rapidly in size, and ascites was discovered in October. Œdema of the legs soon appeared, and nodules could be palpated on the surface of the liver, which extended down to the level of the umbilicus. The patient gradually became weaker, and died on December 26, just over seven months after the removal of the left eyeball.

FIG. 277.—Microscopic section of a secondary deposit in the liver. The infiltration of the liver by the sarcoma is well seen.

AUTOPSY.—There were a few recent adhesions between the left pleuræ in the mid-axillary line, and one of longer standing at the base connecting the visceral pleura to the parietal pleura over the diaphragm. There were no adhesions on the right side.

The left lung weighed 1 lb. 11 oz. Both lobes contained three or four hard white nodules, each with a surface area the size of a sixpenny piece. On section, a number of similar nodules varying in size from that of a sixpence to a half-crown were observed. The lower lobe was congested and was partially collapsed. The right lung weighed 2 lb. 1½ oz. The condition was similar to that of the left, but the nodules were more numerous, and the larger ones on the external surface showed a tendency to pedunculation.

On opening the pericardium, the normal amount of fluid was found. The visceral layer of the pericardium contained three or four hard white nodules. The heart weighed 1 lb. 2½ oz. On the posterior surface of the left ventricle a secondary nodule the size of a Barcelona nut was found.

On opening the peritoneal cavity about 3 pints of blood-stained fluid were found. There were a few adhesions—especially between the liver and diaphragm. A small, white, hard nodule, the size of a pea, was seen in the parietal layer in the region of the splenic flexure, and several about the same size were seen in the parietal layer to the outer side of the ascending colon.

The liver weighed 17 lb. 9 oz. It extended to the level of the umbilicus, and the whole surface was studded with hard white nodules varying in size from that of a threepenny-bit to a duck's egg. One or two of the smaller ones showed umbilication. The proportion of liver tissue to new growth was about 1 to 10. On section, there was a similar appearance, but some of the nodules were much larger (*see Fig.* 276), and the left lobe contained one 7 in. across, which had broken down in the centre and was infiltrated with blood. The little liver tissue present showed marked signs of fatty degeneration.

The pancreas contained a number of small nodules the size of split peas, and the proportion of pancreas to new growth was 1 to 1. Attached to the surface of the pancreas, and adherent to the diaphragm, was a large mass 5 in. in diameter, of retroperitoneal new growth; the mass was white, lobulated, and hard.

The right kidney weighed $7\frac{3}{4}$ oz. It was normal in size, and contained a white hard nodule in one of the lower calices.

The left kidney weighed $7\frac{3}{4}$ oz. There were two or three small nodules in the perinephric fat, and a small nodular growth was seen in the substance of the cortex of the kidney.

Histological sections were cut of the liver, and of the nodules which were present in the lungs, kidneys, heart, pericardium, pancreas, retroperitoneal glands, and parietal peritoneum. In each case fibrosarcoma was obvious.

Fig. 277 shows very clearly the infiltration of a fibrosarcomatous deposit in the liver.

REVIEWS AND NOTICES OF BOOKS.

Hernia: its Anatomy, Etiology, Symptoms, Diagnosis, Differential Diagnosis, Prognosis, and Operative Treatment. By LEIGH F. WATSON, M.D., Associate in Surgery, Rush Medical College, Ill. Imperial 8vo. Pp. 660, with 232 illustrations. 1924. London: Henry Kimpton. 52s. 6d. net.

THE author has compiled a very comprehensive treatise on the subject of hernia in all its aspects, and deals with all common and uncommon conditions so completely that his work must remain for many years the most authoritative treatise on the subject. The description of the different varieties of inguinal hernia is clear, and avoids unduly complicated detail. The figures depicting the varieties of this type illustrate the text, and should be easy to bear in mind, and here, as throughout the book, the illustrations are unusually well drawn and beautifully reproduced. In dealing with treatment—and this applies equally to other sections of the volume—the author is inclined to give details of so many methods claiming to be radical cures, without any suggestion as to the indications for one particular operation, or comparison of results which may be obtained by any particular method, that we fear the book will fail to be of any great assistance to anyone looking for guidance as to the best method to be employed. In dealing with congenital inguinal hernia, one of the most important considerations is the treatment of the ectopic or undescended testicle. Much has been written on this question, and most surgeons of authority hold strong if divergent views as to what should be done, and when operation should be undertaken on undescended testicles. We must admit to disappointment that in a volume of this nature the question is dismissed in less than a page, and we fail to find any discussion on or suggestion as to a variation in treatment if both testicles are descended, as compared with one; whereas, in our knowledge, the view of many surgeons of great clinical experience is that the two conditions may demand entirely different treatment.

The chapter on ventral hernia is perhaps the best, and should be useful to those having difficulty with the very troublesome cases resulting from suppurating appendix wounds. We are glad to notice that the author favours the closure of such gaps by autoplastic fascial flaps when required, rather than by the insertion of metallic substances such as filigrees. We confess we are unable to agree with the author when he prefers the femoral to the inguinal route in operating on a femoral hernia. We do not see how by this route the femoral canal can be closed at the only point at which its closure is of value, namely, at its neck; nor can we admit that the inguinal operation leads to a weakening of the inguinal canal, for such weakening does not result from operation for an inguinal hernia in which exactly the same tissues are divided and resutured; if this opinion is correct, there can be no comparison between the two routes.

There is no more difficult problem than how to deal with a large sliding hernia: here this particular variety is clearly classified, and the problems which have to be faced in its treatment are argued without undue dogmatism. In looking through the volume we see many rare varieties of hernia and complications are dealt with. We have only looked in vain for one which passed through our mind, and that is hernia into the broad ligament.

Like the majority of such volumes coming from the United States, the book is beautifully bound and printed.

Diseases and Injuries of the Rectum, Anus, and Pelvic Colon. By J. RAWSON PENNINGTON, M.D., F.A.C.S., Proctologist to Columbus Hospital, Veterans' Hospital No. 30, and U.S. Marine Hospital, etc. Medium 8vo. Pp. 993 + xii, with 2 plates and 677 illustrations. 1923. Philadelphia: Blakiston, Sons & Co. London: Stanley Phillips. 60s. net.

THE author says in his preface that, as twenty years have elapsed since the publication of the treatise on proctology by the late James P. Tuttle, the time seems ripe for another inventory of the different affections of the rectum, anus, and pelvic colon. A novel feature of the work is the publication at the commencement of each chapter of the portraits of those surgeons who have been interested in proctology since the time of Hippocrates, a drawing of whom, made from a marble bust in the Louvre, appears on the first page.

The opening chapters are concerned with a description of the splanchnosomatic funnel and a commentary upon rectal diseases in general. Chapter 3 deals with the preparation and the examination of the patient. An excellent account of the various instruments used in anoscopy and proctoscopy is given. The important subject of constipation is fully considered in the following chapter, in which we are pleased to find that colectomy is not considered to be the only means of effecting a cure of this very common condition.

A very clear account of the lymphatic systems in connection with the rectum is contained in the chapter devoted to anatomy.

Wounds of the rectum are discussed in Chapter 7, the treatment of gunshot injuries receiving special attention. All authorities appear to be agreed that laparotomy should be performed in cases of penetrating wounds of the intra-peritoneal portion of the rectum. Some difference of opinion exists as to whether colostomy or enlargement of the external wounds only, in order to provide adequate drainage, is the best treatment for penetrating wounds situated below the peritoneal reflection. In our experience the question of resorting to colostomy is largely influenced by the size of the wound in the rectum. Small wounds, such as those caused by a bullet, only require perineal drainage in order to obviate perirectal cellulitis; but large wounds made by fragments of shell invariably require colostomy in addition to adequate perineal drainage.

The various causes and methods of treatment of pruritus ani are fully discussed in Chapter 10. We are in agreement with the view expressed that the great majority of cases are caused by pre-existing disease in the anal canal, such as internal piles, fissure, submucous fistula, and hypertrophied anal papillæ, and are therefore curable. The most intractable cases are those in which there is no discoverable exciting cause, and occur in individuals of a neurotic temperament.

For the treatment of fissure in ano the author advocates the use of a speculum whose blades are capable of being widely opened for the purpose of divulsing the external sphincter. He also recommends that, when the operation of incision is employed, the external sphincter muscle should be completely divided on one or other side of the fissure. In our opinion it is unnecessary to divide any of the fibres of the muscle in order to cure a fissure, as division of the fibrous deposit in the submucosa of the lower part of the anal canal generally suffices. When, however, the muscle is divided, the section is best made at the junction of the middle and posterior thirds in order to inflict as little damage as possible on the nerve supply.

Chapters 13 and 14 are concerned with abscess and fistula. The author's classification of fistulæ is novel. First of all he divides fistulæ into complete and incomplete, and then goes on to say that the latter are not fistulæ but sinuses, as they only present a single opening either internal or external. Complete fistulæ he considers to be true fistulæ, as they have both internal and external openings. Complete fistulæ are divided into three varieties according to the position of the internal opening; thus, when the internal opening is situated in the anus, an anal fistula is said to exist; in those cases in which the internal opening is located at the junction of the anal canal and the rectum, the fistula is described as anorectal; and lastly, when the internal opening is found in the rectum proper, a rectal fistula is the result. Our objection to such a classification as this is that it does not indicate

the various types of fistula that may be met with. We consider that the particular type of a fistula is determined, not by the position of the internal opening, but by the situation of the main track, which is the unobliterated remains of the original abscess cavity that gave rise to the fistula. For example, a submucous abscess may terminate in a fistula of the submucous type, and may present an internal opening at the anal margin, at the junction of the rectum and the anal canal, or higher up in the rectum, so that this type, according to the author's classification, would be described as anal, ano-rectal, or rectal according to the position of the internal opening. Moreover, a pelvirectal fistula having an internal opening in the rectum above the level of the levatores ani would also pass under the name of a rectal fistula, the term being thus applied to fistulæ of vastly different types.

The subject of hæmorrhoids is fully dealt with in Chapter 18. The various operations are carefully described. The Whitehead method is condemned. Of all the methods of operating the author prefers his own, which is known as the open method. We confess to having had no experience of it; but from the author's description we should imagine that the cutting off of part of the hæmorrhoidal tumour, without previously applying a clamp to its base, might result in the patient losing a considerable quantity of blood. This is an important consideration in patients who may have been reduced to a condition of anæmia on account of previous hæmorrhages. We think, therefore, that this method is inferior to that advocated by Earle, who first places a clamp on the base of the pile, then cuts off the pile superficially to the clamp, and places a running suture along the clamped edge to control hæmorrhage when the clamp is removed.

Carcinoma of the rectum is extensively discussed in Chapter 22. A careful summary of recent work in regard to the manner in which cancer spreads from the rectum to the surrounding tissues is given, the author rightly insisting that post-operative immunity from recurrence can only be expected from an operative procedure which has been planned in accordance with the pathology of the spread of the disease. For this reason he prefers the abdominoperineal method to all others. The remainder of the book is concerned with the diseases and injuries of the pelvic colon.

The book is exceedingly well written and profusely illustrated, and we congratulate the author on having produced an excellent compendium, which should be in the possession of all those who are interested in diseases of the rectum and the progress of proctology.

Hæmorrhoids, their Ætiology, Prophylaxis and Treatment by Means of Injections. By ARTHUR S. MORLEY, F.R.C.S., late Temporary Assistant Surgeon to St. Mark's, Hospital for Cancer, etc. Demy 8vo. Pp. 114, illustrated. 1923. London: Oxford Medical Publications. 6s. net.

IN the preface of the book the author expresses the desire to clear up the confusion that exists in the minds of the profession in regard to the varieties of piles met with, and to familiarize its members with the method of treating piles by interstitial injections.

The opening chapter contains a brief account of the hæmorrhoidal veins and the anatomy of the anal canal. We do not agree with the statement that the middle hæmorrhoidal veins enter into the formation of the venous plexus about the lower part of the anal canal and the skin surrounding the anus. It is our belief that the middle hæmorrhoidal veins arise in a plexus situated on the outer surface of the rectum immediately above the levatores ani, and receive blood chiefly from the muscular coat of the bowel, taking little or no part in the formation of either the submucous or the subcutaneous portions of the hæmorrhoidal plexus. Another statement that must be new to anatomists is that the sinuses of Morgagni are situated above the anal valves, and that the anal valves are located at the mucocutaneous junction.

Chapter 2 deals with the etiology and prophylaxis of hæmorrhoids, and in the succeeding chapter external hæmorrhoids are described. We think that the term hæmorrhoid, when applied to the conditions mentioned, is a misnomer, because they do not bleed, and we much prefer the term pile, as it signifies a lump or swelling.

Internal hæmorrhoids are described in Chapter 4, a good account being given of the pathological changes that may take place in the course of their existence. Symptomatology receives ample consideration, but there is no mention of the number of internal hæmorrhoids that may develop, or of their position in regard to the circumference of the anal outlet. We regard this as a matter of considerable practical importance, because it not only enables the observer to record the number of hæmorrhoids that actually exist when he makes his examination, but renders it possible for him to determine accurately, even after the lapse of several years, that a particular hæmorrhoid, which he has either injected or removed by operation, has or has not recurred. It seems curious that the only illustration that has been chosen to depict the appearance of prolapsed internal hæmorrhoids is a typical example of the condition known as prolapsus mucosæ recti.

In Chapter 7 the author describes the technique of his method of injection. He especially emphasizes the point that all the existing piles should be injected at the same time whenever possible. The details of the technique are clearly set forth, and many useful hints are given for the guidance of those who are desirous of carrying out the method. As a rule, four injections of every pile, at intervals of a week, are required, so that three weeks are usually necessary to complete the treatment. When discussing the pathological effects of injection in Chapter 8, the author states positively that thrombosis plays no part whatever in the process. It is of course difficult to disprove this, but it does not seem reasonable that all the blood contained in a mass of dilated and tortuous veins should escape coagulation when the vessels themselves are exposed to the action of a powerful irritant. Chapter 9 deals with complications, recurrence rate, and statistics. Recurrence takes place in 16·6 per cent of the cases treated by the injection method, representing therefore a large proportion of failures. In this respect the method compares unfavourably with the operation by ligature. When an internal pile has been completely removed by ligation it cannot possibly recur. In estimating recurrence, a subsequent development of piles that did not exist at the time of the first operation should not be regarded as recurrence. The final chapter is concerned with a discussion of the advantages and disadvantages of injection, the complications after various operations, and the contra-indications to treatment by injection.

The book shows that the author has gained considerable experience in this particular method of treating internal hæmorrhoids, and has made out a good case for its adoption in suitable instances, but we cannot help feeling that it is a pity that he should allow himself to indulge in abuse of those whose opinions do not coincide with his, by a remark on page 65 that they "are either exercising their imaginations freely or are making wilful misstatements".

The Toxæmia of Acute Intestinal Obstruction: or Vomiting as a Pathological Force. By R. H. PARAMORE, M.D. (Lond.), F.R.C.S. (Eng.). Crown 8vo. Pp. 66 + viii, with 1 chart. 1924. London: H. K. Lewis & Co. Ltd. 5s. net.

THIS volume, the author tells us, is the outcome of a criticism of the view that the visceral disabilities in eclampsia are determined mechanically, and that puerperal convulsions are simply uræmic in nature. Having criticized and rejected the commonly accepted view that the renal impairment in acute intestinal obstruction is due to toxins absorbed from the damaged gut, he seeks to establish the theory that it results from the increased intra-abdominal pressure. The renal function, according to this view, is interfered with in a purely mechanical manner, thus leading to an accumulation of non-protein nitrogen in the blood. Vomiting, by increasing

the intra-abdominal pressure, is, in intestinal obstruction, a prime factor in the causation of diminished renal efficiency. The objection that fits do not occur in acute intestinal obstruction, whilst they do in eclampsia, is disposed of by the statement that as patients with acute intestinal obstruction constantly vomit, " the material determining fits is voided ".

The arguments are not easy to follow, on account of the peculiar literary style in which they are presented. On one page, for instance, there are as many as eight rhetorical questions, and on another no fewer than eight sentences or words enclosed within brackets after the manner of stage asides.

A Manual of Practical X-ray Work. By JOHN MUIR, M.B., Ch.B., B.Sc., in collaboration with Sir ARCHIBALD REID, K.B.E., C.M.G., M.R.C.S., L.R.C.P., and F. J. HARLOW, B.Sc., F.Inst. P., A.R.C.Sc. Third edition of the Manual by ARTHUR and MUIR. Royal 8vo. Pp. 524 + x, with 456 illustrations. 1924. London : Wm. Heinemann Ltd. 31s. 6d. net.

THIS book was first published under the joint names of Drs. Arthur and Muir. Of the present edition the authors' names and qualifications are a sufficient guarantee of the quality of the work. Much of the thoroughly practical side of the publication is traceable to the great experience of the late Sir Archibald D. Reid, and no doubt many of the illustrations are the outcome of the work he carried on throughout the years of his active life. Dr. Harlow is probably largely responsible for the physical and technical sections of the volume, and this part of the work can be confidently recommended as a guide to the student and the beginner in radiography. Dr. Muir has had a large technical experience from which he has drawn freely to make the book a thoroughly practical and reliable guide. Nearly half the volume—the first eight chapters—is devoted to a general consideration of the subject, and contains descriptions of modern apparatus, information regarding the use of X-ray installations, and the technique of the subject. The important section on photographic technique is full of useful information. Stereoscopy is adequately dealt with. These chapters are admirably illustrated.

The chapter devoted to normal radiography is carefully dealt with, many useful diagrams are incorporated, and each has a teaching value. The development of the bones is fully discussed : this difficult yet interesting study being worthy of all the care which has been bestowed upon it. The student reading for an examination in radiology would be well advised to study this subject carefully.

A consideration of the morbid conditions of the several systems is next elaborately dealt with, many valuable skiagrams are shown to elucidate difficult points in diagnosis, and the differential diagnosis of the various diseases is satisfactorily given.

The book on the whole should prove to be of value to beginners in radiology : the advanced worker will not fail to find in its pages much valuable information. No attempt has been made to deal with the treatment side of radiology, though the title might lead the reader to look for some information on the subject. The work deals exclusively with radiography, and as such must supply a want on the part of beginners.

The illustrations of skiagrams, though instructive, are not up to a high standard ; this no doubt may be due in part to loss of detail in reproduction ; in future editions we may look for an improvement in this respect.

We can confidently recommend the work to all radiologists, and professional men who are interested in the subject. The practising physician and surgeon will find in its pages much useful information regarding the difficult diagnosis of diseases of the various systems with which they deal ; we would particularly recommend for their consideration the chapters on the diseases of the chest, the alimentary, and the urinary systems. Obstetricians will find useful information regarding the use of X rays in their specialty in the short chapter on radiology in obstetrics.

St. Bartholomew's Hospital Reports. Vol. LVII, Part I. 4to. Pp. 91, illustrated. 1924. London: John Murray. 10s. 6d. net.

THIS would be rendered delightful if for no other reason than that it contains a picture of Smithfield Market in 1830, which as a reproduction of the best kind does great credit to the House of Murray who reproduced it. H. W. W. contributes a sympathetic biography of Harrison Cripps, and does not stoop to spoil his material by omitting to mention the faults which he, in common with other men of his strength of character and confidence, possessed. Keynes' article on "Twenty-one Cases of Actinomycosis" is of a type which such reports seem to live on and perpetuate. It adds a small amount of fresh clinical material to a subject already fully dealt with, but breaks no new ground nor adds any suggestion of scientific value. We have read Dunhill's paper on the parathyroids elsewhere. It is a well-worked-out study, and beautifully illustrated.

An Introduction to Surgical Urology. By WILLIAM KNOX IRWIN, M.D. Aberd., F.R.C.S. Edin., Hon. Casualty Out-patient Surgeon, St. Paul's Hospital for Genito-urinary Diseases. Crown 8vo. Pp. 180 + viii. 1923. London: Ballière, Tindall & Cox. 7s. 6d. net.

IN this book the writer sets out to describe the main facts of genito-urinary surgery 'in short compass'. Two chapters are devoted to anatomy and the examination of the patient, seven to the chief genito-urinary symptoms, and one chapter to glandular hyperplasia and malignant disease of the prostate. The plan of the book is to group the diseases of the genito-urinary system under their most prominent symptoms so as to make the diagnosis more easy. The result is somewhat confusing, for, under the heading of a symptom, the author drifts off to discuss the various methods of treatment of the medley of diseases that may cause it. Hæmaturia may be taken as an example. There is no real attempt to consider hæmaturia as a symptom and to track it to its source, and diagnose the cause. The author, after a few preliminary lines, plunges into a description of the diseases that have hæmaturia as a symptom. The account of the diseases of the genito-urinary tract is sketchy and, in many diseases, inadequate.

The book contains much information that will be useful to the general practitioner, but we doubt if it is presented in a form which he will readily assimilate.

The Gall-bladder: Its Past, Present, and Future. By J. E. SWEET, A.M., M.D., Sc.D., Professor of Surgical Research, University of Pennsylvania. Medium 8vo. Pp. 39, illustrated. Paper Covers. Philadelphia: J. B. Lippincott Co.

THIS is a reprint from *International Clinics* of the Mütter Lecture delivered before the College of Physicians, Philadelphia, in December, 1923. In it are reviewed the writings of many other workers upon the subject. There is little that is new, and most of the novelty lies in the guess-work. The author concludes that "under normal conditions whatever passes into the gall-bladder through the cystic duct never passes out again through the cystic duct". The very slender evidence in favour of this view will probably leave every reader unconvinced.

The elastic layer in the wall of the gall-bladder attracts no attention, nor does the possible function of the viscus as a concentrator of the fluid within its cavity. We are not always quite sure of Dr. Sweet's meaning, for his use of the English language is not a little slipshod. On page 2 he refers to "the longitudinal section of an embryo of 2 mm. or between 3 and 4 weeks" and seems therefore to suggest that a week is shorter than a millimetre. He frequently uses the word 'theory' when he means 'hypothesis'.

The pamphlet is accompanied by a memorandum from the manager of the medical department of the publishing company written in the laudatory style which we are accustomed to see upon the paper covers of those cheaper and more lurid types of novels displayed upon the railway bookstalls.

Orations and Addresses. By Sir JOHN BLAND-SUTTON, President of the Royal College of Surgeons of England, Consulting Surgeon to the Middlesex Hospital. Fcap. 4to. Pp. 161 + xii., illustrated. 1924. London: William Heinemann (Medical Books) Ltd. 10s. 6d. net.

THESE orations and addresses have already appeared in print, two of them in the pages of this Journal, but they are none the less welcome in this collected edition. Like all Sir John's writings, they read easily and are well illustrated. They range from an attempt to explain on natural grounds the miracles which led to the escape of the Israelites from the bondage of Egypt, to a study of the choroid plexuses of the brain. The most interesting is an account of the Aguaruna Indians, their method of making shrunken mummified heads, and their habit of wearing ear plugs and labrets ; the most brilliant is the Hunterian Oration delivered on the anniversary of John Hunter's birthday, February 14, 1923. There is a good index, and the illustrations are well reproduced, but in consequence of these illustrations the weight of the book is out of proportion to its size.

Guisei si Cretinizmului in România (Goitre and Cretinism in Rumania). By DR. LIVIU CÂMPEANU, Edit. Instit. Art. Graf. " Ardealui " Cluj (Koloszvar, Klausenburg). Pp. 196. 1924.

THIS excellent little book is the outcome of much painstaking and valuable research on the part of the author, the head of the surgical clinic of the University of Cluj. Although written mainly in Rumanian, it contains a very full abstract of twenty-five pages in French, and the detailed statistical tables which occupy some sixty pages present no real difficulty, even to those who have no knowledge of the former language.

The book consists of three parts. The first deals with the detailed results of a systematic and exhaustive inquiry by the author into the distribution and causation of goitre and cretinism in the whole country. Two maps illustrate this part of the subject. The second part is concerned mainly with the surgical treatment of goitre as carried out in the Cluj clinic under the direction of Professor Iacobovici, chiefly in the years 1919–22, during which 122 cases of goitre were operated upon. The various kinds of goitre, the nature of the operations, and the results are all faithfully described with considerable and useful detail.

Finally, there is a short account of some interesting experimental research work carried out by the author upon dogs in which conditions of hypo- and hyperthyroidism had been artificially produced. There is also a useful bibliography of eight pages, dealing mainly with recent papers in German, French, and English.

Le Vie di Deflusso degli Ascessi Ossifluenti (The Course pursued by Abscesses originating in Bone). By Dr. SANZIO VACCHELLI. 8vo. Pp. 160, with 68 illustrations. 1923. Bologna: Licinio Cappelli.

THIS book is an interesting study of the paths traversed by the extending tuberculous process originating in bone, whether of the spinal column, the pelvis, the bones of the hip-, knee-, or shoulder-joints. It covers for the most part ground already well known, but calls in aid the illuminating evidence of radiograms of abscess tracks and cavities delimited by an opaque substance. The most satisfactory material for this use is, the author finds, bicarbonate of bismuth in physiological saline, since it is almost non-toxic.

He arrives at the conclusion that though gravity undoubtedly plays a part in determining the spread, yet it is by no means such a path that is invariably followed ; that in certain situations—for example, the mid-dorsal—an outward and upward direction is frequent even in the absence of recumbency. Moreover, it does not follow, because the initial focus in any two given cases is exactly similar anatomically,

that the abscess resulting will extend by the same route ; the spread is, in fact, that of a tuberculous granuloma.

The most instructive descriptions and illustrations are perhaps those which relate to caries of the three or four upper cervical vertebræ, and to mediastinal abscesses ; for even with the present-day practice of evacuating all tuberculous abscesses by aspiration, more accurate information as to the probable distribution of even the commonest of such lesions is desirable—and this book affords it. It is another of the admirable publications based on the rich clinical material of the Rizzoli Institute.

L'Intestino Crasso Prossimale (The Proximal Large Intestine). By Dr. ARRIGO MONTANARI, Senior Medical Director of Radiology in the Umberto I Hospital at Ancona. Pp. 177, with 65 illustrations. 1924. Bologna : Licinio Capelli.

THIS book deals with the radiology of the upper half of the large intestine. The author, who is a disciple of, and was formerly assistant to, Professor A. Busi, follows the technique of the latter. On the day preceding the commencement of the examination, the large intestine is cleared by simple enemata. Purgatives are scarcely ever employed, as they influence unduly the motility of the intestine during the examination. The opaque enema used in the examination consists of 100 grm. of sulphate of barium suspended in 400 c.c. of liquid. The barium sulphate must be very pure, since the addition of traces of chloride renders it dangerously toxic.

The first third of the book deals with the normal anatomy and physiology of the large intestine in relation to radiology. The second part deals with pathology. The various pathological conditions are classified according to the symptoms which they produce. Successive chapters deal therefore with modifications of position, size, and shape of the intestine, with alterations in passive mobility, and with alterations in tone and motility.

The author lays stress on the fact that normally the colonic contents are propelled by two series of movements. One is very slow but continuous, and involves mainly the sacculi. The other is very rapid and intermittent, occurring only at long intervals (several hours). It is only during this latter movement that extensive forward propulsion of intestinal contents takes place in the colon.

The book is well printed on good paper, and the illustrations, nearly all of which are radiograms, are good and clear. A bibliography of four pages deals with Italian, French, English, German, and American literature. There are indexes of authors and subjects.

Le Paralisi Ishemiche (Ischæmic Paralysis). By FRANCESCO DE RAFFELE. Crown 8vo. Pp. 388, with 74 illustrations. 1923. Bologna : Licinio Cappelli.

THIS volume is the third of the monographs published by the Rizzoli Institute, and, as Professor Putti says in his introduction, no one who wishes to undertake the study of this important clinical and pathological chapter can afford to neglect it. The history, the etiology, pathogenesis and physiological pathology, symptoms and course, diagnosis, pathological anatomy, and treatment all receive due attention ; there are records of 23 cases from the Institute, and full abstracts of 244 from the literature ; also records of the author's experimental studies and those of others.

But when all is said, interesting and instructive as this industrious compilation certainly is, it must be admitted that with the best will in the world the author has not been able either to disentangle a clear-cut clinical entity or to establish unequivocally its pathology—or perhaps it should rather be said that few cases can be found to conform to any definition, however carefully drawn, since ischæmia as the sole and exclusive exciting process is as rare as the phœnix.

De Raffele is on the whole an advocate of a purely myogenous etiology, but his own and other clinical examples often have definite nerve-trunk lesions as a prominent feature. He adopts the 'acute inflammatory' explanation of the

initial phase, and, a little disingenuously, adopts that definition of inflammation (from among the four-and-sixty possible—is it ?) which reconciles the findings with the absence of infection or infective agents.

In describing the histological changes in the muscle, the fibrous-substitution, the action of histocytes, the indications of regeneration, he notes the interesting point that no trace of *fatty* degeneration is observable. As regards treatment of the established condition in the forearm, he is, seemingly, an advocate of osteoplastic shortening of the radius and ulna, but admits the possible advantages of tenoplasty in special circumstances, and of course neglects neither mechanical nor physiotherapeutic accessories. He recognizes that his experimental results must, like those of others, be considered as negative.

Whilst the author has not provided a final solution of the problems of ischæmic paralysis, he has produced a compact and well-arranged monograph.

A Manual of Surgical Handicraft and Physiotherapy. Vol. I. By J. RENFREW WHITE, M.S. (N.Z.), F.R.C.S. (Eng.), Assistant Surgeon and Surgeon in Charge of the Orthopædic Department, Dunedin University. Demy 8vo. Pp. 566 + xxi, with 344 illustrations. Dunedin, New Zealand: Coulls Somerville Wilkie Ltd.

ONE cannot read Mr. Renfrew White's book without feeling astonished at the enormous amount of material that he has condensed in it, and at the tremendous care that he has taken in collecting practical details of surgical methods. The first chapters on asepsis, antisepsis, and methods of sterilization present nothing out of the ordinary; the next two on the use of antiseptics and on surgical materials are a compendium of details of all sorts of antiseptic solutions and their methods of use, and of the preparation and sterilization of all surgical materials. For example, the preparation, hardening, chromicizing, and seven different methods of sterilization of catgut are described; details of preparation of solutions, of all sorts of materials such as pastes, and of hypodermic and intramuscular injections, are all given. The illustrations of methods of bandaging appear to be the most practical that have yet appeared in any text-book, and it would be hard to discover any part of the body the bandaging of which is not illustrated by two or three adequate methods. Much care is given to instruction in the tying of knots and in the use of all kinds of ligatures and sutures, details of technique elaborated by many different surgeons all being included.

Further chapters discuss preparations for operation, general operative technique, and post-operative care, and there are small sections on the treatment of wounds and ulcers, sinuses, fistulæ, etc.

This first volume deals only with surgical handicrafts. It is a book which one may say is of such value that it should be in the hands of every surgeon and every theatre sister. There is scarcely anything likely to be wanted in theatre technique that cannot be found in it. Presumably the second volume will deal with physiotherapy, and it will be looked forward to in the hope that it will reach the same high standard as does the first volume.

Care and Cure of Crippled Children. Part I, being a description of the National Scheme for the Welfare of Crippled Children, by G. R. GIRDLESTONE, F.R.C.S. Part II, being a Year-book of Hospitals, Schools, and other Institutions for Crippled Children, by Mrs. HEY GROVES. With a foreword by Sir Robert Jones, K.B.E., C.B. Demy 8vo. Pp. 88, with illustrations. 1924. Bristol: John Wright & Sons Ltd. 2s. 6d. net.

THE Central Committee for the Care of Cripples has set itself as its post-war problem the organization of the care of cripples throughout the country. The experience of military orthopædic hospitals and of treatment clinics demonstrated so clearly the importance of team work and of adequate after-care in orthopædic surgery, that to lead on to a similar organization for the care of the civilian cripple became the obvious line of development.

In this little book an outline scheme for such organization is set forth in considerable detail by Mr. Girdlestone. The arrangement and organization of a central orthopædic hospital, and the co-ordination with it of clinics amounting really to subsidiary out-patient departments, are set out in a way which is both convincing and practically helpful to those who wish to assist in extending the organization in parts of the country where it is not yet in existence. The map of England showing the existing hospitals and clinics has far too few of its counties properly filled; it has many large blank spaces where organized care of cripples is at present entirely wanting. For example, with the exception of one hospital for tuberculous disease, the whole of the Eastern Counties is a blank, and Wiltshire, Dorsetshire, Somersetshire, Devonshire, and Cornwall have no orthopædic hospital or clinic at all.

In the second section of the book Mrs. Hey Groves has collected facts about hospital schools and other institutions for crippled children which are at present in existence, with brief historical notes about them. In some of these the history given is both helpful and fascinating; for example, the Shropshire Orthopædic Hospital was founded in 1900 and then held only four girls and four boys, an old house, formerly a ladies' school, being utilized. At the present time it has 350 beds and a yearly expenditure of over £42,000. No doubt the history of many of the other institutions would be just as convincing if it were told.

The book is a small one, and should be in the hands of everyone who is interested in the crippled child. By a study of it, not only is it possible to help to organize treatment on the right lines, but it is also possible to know what parts of the country are particularly in need of organization, so that those who have the desire to do something may choose the district for which they can work.

Cancer Research at the Middlesex Hospital, 1900–1924: Retrospect and Prospect. Compiled by Members of the Staff of the Hospital and Medical School. Edited by W. Sampson Handley, M.S., F.R.C.S. Demy 8vo. Pp. 90. 1924. London: John Murray. 3s. 6d.

This small book sets forth in popular form the work that has been done at the Middlesex Hospital in the investigation of cancer. It is written not for the scientific worker but for the general reader, appealing to him for support. The task is admirably carried out, and the book calculated to give the general public a true conception of the problems and difficulties of cancer research, and what has been done by workers in this field at the Middlesex Hospital.

Cancer du Rectum. By Professors André A. Chalier and Henri Mondor. Royal 8vo. Pp. 601, with 105 illustrations. 1924. Paris: Octave Doin. 40 francs.

This is one of several volumes dealing with cancer of different organs and regions of the body which are being published under the editorship of Professors Hartmann and Bérard. The authors have divided the book into two parts, the one dealing with carcinomata and the other with sarcomata.

Two types of carcinomata are met with, the squamous-cell carcinoma at the anus or in the lower part of the anal canal, and the adenocarcinoma in the rectum proper. Three varieties of the adenocarcinoma are described, namely, the papilliferous, the infiltrating, and the colloid. These growths are met with (1) below the level of the levator ani, (2) between the levator and the peritoneal reflection, and (3) between the peritoneum and the rectosigmoidal junction. So far as the experience of the authors is concerned, the commonest site is the anterior wall of the bowel. In our experience the distance of the growth from the anal verge appears to influence its position. Thus, when the growth involves either the anal canal or the lower part of the ampulla, the anterior wall is most commonly affected; when the growth is situated in the upper part of the ampulla, the postero-lateral wall of the bowel is

usually affected; and lastly, when the rectosigmoidal junction is the starting-point of the disease, the whole circumference is generally involved.

In the chapter on pathological anatomy the extramural lymphatic channels by which cancer cells, detached from the original growth, are carried to distant parts, are well described. The authors have found from repeated dissection of specimens that the group of anorectal glands situated at the bifurcation of the superior hæmorrhoidal artery are invariably invaded, even when the primary growth is in a comparatively early stage of development. They also point out that spread in the extramural tissues takes place chiefly in an upward direction along the line of the superior hæmorrhoidal and the inferior mesenteric vessels, and thence towards the median aortic lymphatic glands situated near the origin of the inferior mesenteric artery. They have not been able to ascertain that spread occurs to any marked extent in the lateral or in the inferior lymphatic areas, and therefore do not regard the tissues through which these lymphatics pass as liable to be invaded in the majority of instances. We are surprised that they have not encountered metastatic deposits in the tissues of these lymphatic areas during the performance of operations, because, when discussing operability, they state that the only contra-indications to operation are general dissemination and involvement of the ureters and the urinary bladder. Consequently they must have performed operations in cases in which extramural extension of the disease was fairly well advanced. We have repeatedly observed metastases in the substance of the levatores ani in cases in which the primary growth had not penetrated the entire thickness of the rectal wall, and have detected microscopical foci in the ischiorectal fat as the result of the systematic examination of specimens removed by operation.

We do not agree with the authors in their belief that the chief path by which the spread of cancer of the rectum takes place is in the submucous tissue. Recent observations upon this point conclusively prove that spread in the submucous tissue is very limited, and does not extend more than a few lines either above or below the macroscopical margin of the primary growth. In support of this view we may also say that we do not know of a museum specimen showing a submucous metastasis among the numerous examples of rectal cancer.

When discussing the implication of extramural lymphatic glands, attention is rightly drawn to the fact that enlargement of glands does not necessarily imply invasion by cancer cells, because the enlargement may be due entirely to inflammatory conditions associated with the septic nature of the cancerous ulcer.

The chapter dealing with the symptomatology of the successive stages of a cancerous growth is particularly good, attention being drawn to the importance of recognizing early symptoms before the disease has progressed beyond the stage of operability.

The major part of the book is devoted to the consideration of methods of treatment. It is pointed out that the treatment of cancer of the rectum is purely surgical, and that medical measures are of little avail. For cases that have passed beyond the stage of operability, the establishment of an artificial anus is essential. Left iliac colostomy is the method of choice unless the pelvic colon is so distended that it is impossible to withdraw from the abdomen a loop of sufficient size to create an efficient spur. In such instances the authors regard cæcostomy as the best procedure. There is no mention of the possibilities of transverse colostomy under these circumstances. After describing in detail all of the operative procedures that have been advocated for the removal of the cancerous rectum, the authors insist that the most radical removal is that effected by the combined abdominoperineal route, as by this means alone can the tissues involved by the upward spread of the disease be eradicated. The question as to whether the internal iliac arteries should be ligatured, as a preliminary step in the abdominoperineal operation, is discussed at considerable length, and the method of applying the ligature is fully described. We think that ligature of these arteries is an unnecessary procedure, because the only artery that supplies the rectum from that source is the middle hæmorrhoidal, which is usually so small that it seldom requires a ligature. When discussing the operation mortality following the abdominoperineal method, the authors draw

attention to the fact that, although formerly the mortality rate was as high as 50 per cent, it has now been reduced to about 17 per cent. The recurrence rate is estimated at 20 per cent, which is vastly superior to that shown by any other method.

The remainder of the book is devoted to consideration of the sarcomata that are met with in the rectum. These are divided into the melanotic and the non-melanotic. The histological appearances are fully described. The treatment recommended is wide removal whenever possible.

We congratulate the authors on having produced an excellent book, and consider that their views on the subject admirably express present-day knowledge of the pathology and surgery of cancer of the rectum.

Tuberkulose der Knochen und Gelenke. By PROFESSOR F. OEHLECKER, Chief of the Surgical Clinic at Hamburg-Barmbeck. Quarto. Pp. 405, with 356 figures in the text. 1924. Berlin: Urban & Schwarzenberg. $40.

THIS is a book of moderate size, well illustrated and interestingly written. The various phases of the subject are dealt with in due proportion, except that there is but little description of surgical operations or technique. As regards etiology, the author considers that infection is chiefly by way of the air and the tonsils. Tuberculous affection of bones and joints is described as a general disease with local manifestations. Prominent importance is given to light treatment both by the sun and artificial radiation. In the treatment of special lesions, the book gives a good account of plaster splinting, but is rather scanty in regard to other methods.

Études médico-radio-chirurgicales sur le Duodénum. By PIERRE DUVAL, JEAN-CHARLES ROUZ, and HENRI BÉCLÈRE. Medium 8vo. Pp. 264, with 127 illustrations. 1924. Paris: Masson et Cie. 35 fr.

THE study of affections of the duodenum apart from duodenal ulcer is of comparatively recent date. In this monograph the three authors, a surgeon, a physician, and a radiographer, have worked in close collaboration, so that the utmost has been done to correlate the general clinical picture and the X-ray observations with the conditions found on the operating table.

The first section deals with the changes which occur in the duodenum in the presence of gall-stones. When there is accompanying periduodenitis, deformations of the bulb occur which defy classification, owing to their irregularity. In a high proportion of cases they are rendered evident only when serial radiographs are taken, and only with the most painstaking care on the part of the radiographer. The impression of the gall-bladder upon the duodenum cap shadow described by George and Leonard is confirmed by the authors, but is not regarded as pathognomonic, since they find that a similar concavity in the shadow may occur with distention of the hepatic flexure of the colon. A new sign they describe is the retraction posteriorly of the pyloroduodenal segment seen only in oblique or lateral views. The interesting observation is made that after cholecystectomy irregularity in the duodenal shadow is almost the rule, as the result of adhesions, yet in many cases there are no symptoms. Sometimes, however, stenosis is so great as to require gastrojejunostomy for its relief.

An important section of the book deals with that curious condition named by the authors 'essential stenosing periduodenitis'. This is a very definite clinical condition found at operation, and presents great problems in treatment. It is systematically described here and cases are quoted. The clinical features are but vague, and consist largely of debility and neurasthenia, perhaps with attacks of pain which simulate duodenal ulcer or biliary colic, so that diagnosis rests solely upon the recognition of the condition of the duodenum by repeated radiography. One leaves this chapter of the book with a feeling of disappointment which cannot be dispelled, and is reminded of the early work on the surgical treatment of visceroptosis. Yet

no surgeon should neglect to read this very valuable account of a pathological condition of which so little is known.

A very good account is given of obstruction of the third part of the duodenum by the superior mesenteric artery. The cases appear to be more common in Duval's practice than they are in this country. Here, too, further knowledge of the pathology of the condition seems necessary before treatment can become standardized.

There is a very good section on the X-ray appearances of duodenal ulceration, and the book is completed by a discussion of duodenal intoxication due to chronic stenosis, a chapter well worth perusal.

A Descriptive Atlas of Radiographs of the Bones and Joints. By A. P. BERTWISTLE, M.B., Ch.B., Resident Surgical Officer, General Infirmary, Leeds. Crown 4to. Pp. 198 + xiv, with 300 radiographs. Bristol: John Wright & Sons Ltd. 17s. 6d. net.

THIS book is a collection of radiographs of the normal bones and joints and of their diseases and injuries. A unique feature is the manner in which the outline of the soft parts is shown as a silhouette. This method considerably enhances the appearance and usefulness of the skiagrams; it brings out well, for instance, the 'dinner fork' deformity of a Colles' fracture or the flattening of the shoulder in a dislocation of this joint, these features being hardly visible in the usual radiograph.

The Atlas consists of six parts: the first illustrates the usefulness and method of making silhouette radiographs, the second being a comprehensive series of skiagrams of normal bones and epiphyses. A most useful feature of this part is the collection of radiographs of the principal joints showing their epiphyses at various ages. The third part is a very complete series of fractures of bones; the fourth depicts diseases of bones; whilst the fifth shows the injuries and diseases of joints. The sixth part is an interesting collection of miscellaneous skiagrams. There is a brief but adequate description of each radiograph.

This book will be found most useful in surgical practice for the comparison of skiagrams whose interpretation is difficult. For the sake of completeness, it is a pity that no skiagrams of the normal spine between the upper dorsal and the sacral vertebræ are given, nor are any diseases or injuries of the spine portrayed.

The radiographs are all excellent, and the publishers are to be congratulated on the way in which they have been conveyed to paper.

Jahresbericht ü. d. gesamte Chirurgie. 27th year of publication. Review of 1921. Pp. 989 + xvi. 1924. Berlin: Julius Springer. $16.40.

THIS well-known review and epitome has now again reached its pre-war standard of excellence. The careful way in which the references are arranged and indexed and the general completeness is a wonderful evidence of great labour and careful co-operation of many workers. When it is mentioned that no fewer than 650 papers dealing with the subject of Roentgen rays are quoted with titles and translation of the title and reference, together with a general critical introduction to this matter, and that all other subjects are dealt with in due proportion, the size and completeness of this undertaking will be realized.

Die Verhütung des Knickfusses und des Knickplattfusses. By DR. AUGUST WEINERT, Chief Surgeon to the Municipal Hospital at Sudeberg-Magdeburg. Pp. 22, with 23 figures in the text. 1923. Berlin: Julius Springer.

A DEMONSTRATION that talipes valgus and flat-foot may be treated by raising the inner edge of the sole and heel of the boot, with a method of measuring the angle of deformity and correction.